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ABSTRACT

A major model to forecast requirements for health professionals, which is currently used by the Division of Health Professions Analysis of the U.S. Public Health Service, is described. Specifically, technical documentation is provided for the projections to 1990 that are presented in "A Report to the President and Congress on the Status of Health Professions Personnel in the United States" (HE 017 122). The model is based on the assumption that recent and current patterns of health services utilization, employment, and productivity will continue into the future. Population is separated into 40 subgroups characterized by the attributes of age, sex, and family income. Twenty categories of health services are covered in the model, and several types of medical office and hospital utilization are developed. Nursing home care, dental care, drugs and laboratory services are included. The services of optometrists and podiatrists are treated both internally and separately from the model. The model examines 28 types of health personnel, and employment in the overall health care industry is related to specific services. Assumptions relating to population, price, and utilization are discussed. The derivation of the health personnel matrix is covered, along with methods/results for allocating specific kinds of care. (SW)

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THE HEALTH PROFESSIONS REQUIREMENTS MODEL

STRUCTURE AND APPLICATION

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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Health Resources Administration

THE HEALTH PROFESSIONS REQUIREMENTS MODEL

STRUCTURE AND APPLICATION

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Health Resources Administration
Bureau of Health Professions
Division of Health Professions Analysis

DHHS Publication No. (HRA) 81-15

FOREWORD

The mission of the Bureau of Health Professions (BHPr), Health Resources Administration (HRA), is to support development of the human resources needed to staff the U.S. health care system. To assist in carrying out that mission, the Bureau's Division of Health Professions Analysis (DHPA) has been assigned the responsibility for analyzing and projecting the supply, requirements, and geographic distribution of health care personnel. One major aspect to the Division's program is the development and refinement of forecasting models for the U.S. health care sector.

This report describes the main forecasting model currently used by the Division to project the requirements for health professionals that are presented in a number of Bureau and Division reports. The model was originally developed by DHPA (formerly the Division of Manpower Intelligence) under Project SOAR (Supply, Output, and Requirements) in 1972, and has been refined and modified significantly since that time. More specifically, this report provides the technical documentation for the projections to 1990 that are presented in A Report to the President & Congress on the Status of Health Professions Personnel in the United States, DHEW Publication No. (HRA) 80-53.

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ACKNOWLEDGMENTS

The preparation of this report, under Howard V. Stambler, Director of the Division of Health Professions Analysis, was supervised by John Drabek, Chief, Supply and Requirements Forecasting Branch, DHPA. Roger Cole, Associate Director for Program Development, James Cultice, Statistician, and other DHPA staff were originally responsible for the development of the model.

Portions of this report were taken from a study conducted by JWK International Corporation under HRA Contract No. 232-78-0140. Leonard Greenberg was the Project Director for JWK. James Cultice was Project Officer on the contract for DHPA.

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Chapter I

OVERVIEW

The BHPr general health care personnel requirements model assumes that recent and current patterns of health services utilization, employment, and productivity will continue into the future. A large amount of data has been assembled in this model to describe the Nation's current health care system and the changes it has undergone over the past decade or two.

In the BHPr model, population is separated into 40 subgroups characterized by the attributes of age, sex, and family income. Age and sex differentials in health service utilization rates are well known. The very young and the elderly are much heavier users than the rest of the population, and women tend to use more health services than men, especially during childbearing years. Family income is strongly associated with several types of health care, especially preventive services and dental care.

Twenty categories of types of health services are covered in the model. Several types of medical office and hospital utilization are explicitly developed. Nursing home care, dental care, drugs and laboratory services are included. The services of optometrists and podiatrists are treated both internally and separately from the model.

Many of the health services analyzed in the model are measured by utilization rates in terms of physical units. Physician and outpatient hospital services are measured in terms of patient visits, while hospital and nursing home admissions measure inpatient utilization. In most instances, utilization rates are computed separately for each of the population groups described above. For example, recent data indicate that, on the average, young adult females have slightly more than one visit to the obstetrician-gynecologist per year, and that there are approximately 14 hospital admissions per year for non-surgical treatment per 100 elderly males. Of course, many individuals within each category will have much lower or higher use of services than are indicated by these rates, but it would be far too complex to measure and project the utilization of health services by specific individuals. Adequate personnel requirements projections are obtained by measuring only the average behavior of a population group.

The BHPr model examines 28 types of health personnel who provide these health services. The model relates employment in the overall health care industry to specific services, largely by distributing the total number of individuals in each occupation across the care categories. For example, for medical doctors who are pediatricians, the model distributes 59 percent of these physicians to office care and 32 percent to hospital care based on empirical data. The remaining 9 percent are allocated to nonpatient care activities, such as teaching in medical schools. No pediatricians are allocated to settings such as nursing homes. However, the model recognizes that some portion of a pediatrician's time is indeed devoted to treating adults. Consequently, only 93 percent, instead of 100 percent, of the pediatricians in the office setting are allocated to pediatric care. Each occupation is distributed across care categories in a similar manner. Some skills are quite specialized-- optometrists provide only vision care. Others are more broadly based--physicians are found in almost all care categories.

Each of the data bases necessary to implement the model was constructed for a year when reliable historical statistics were available. 1975 was selected as the base year of the model. The model assumes that current patterns and trends will not change radically but will move in a largely incremental fashion in future years, except for a few important adjustments described later.

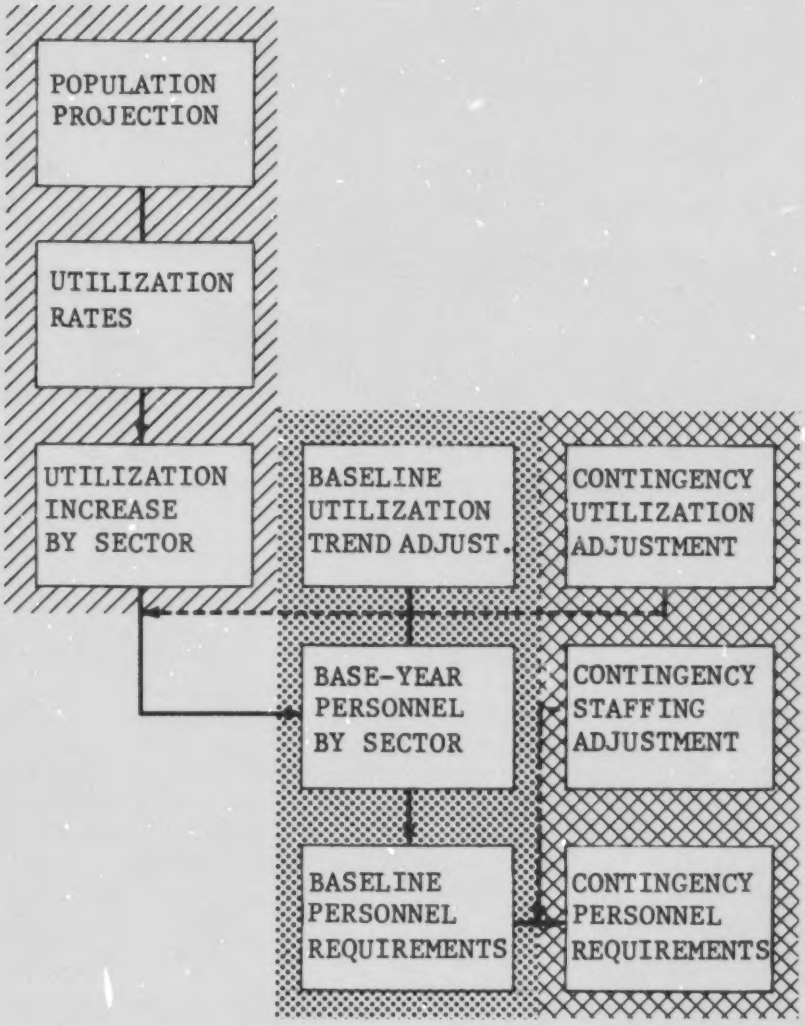
Figure 1 presents a visual overview of the model. This diagram shows each principal component in its logical relationship to the model's other components, all of which are described in detail later in the report. The model can be conveniently blocked into three major functional configurations with each of these configurations further divided into a sequence of steps each of which represents a procedural part of the model. The configuration shown in the diagonally shaded area includes those steps in the model that result in the estimation of population effects on requirements for health personnel. Factors that express changes in the utilization of specific health resources consequent to population changes are generated and passed on to those parts of the model shown in the dotted background. At this stage, the model accounts for the historic trends in per capita utilization, and extends these trends into the future. The model's basic forecasts of requirements are generated in this stage and reflect both population growth and its redistribution, and anticipated changes in per capita utilization conditioned on recent past experience. That part of the model shown in the gridded area can be termed a contingency configuration and allows for potential developments that could materially alter forecasts of requirements based on past trends. Major sources of such developments are national health insurance, health maintenance organizations, expanded roles of midlevel health practitioners, and technological advances.

The first adjustment in the model is made to account for future population growth. The size and composition of the population has been changing and will continue to change over time. To adjust the patterns to reflect the Nation in a future year requires changing the size of each population subgroup. Almost all population groups will increase, but some increases will be larger than others. Relatively more individuals, for example, will enter the older age groups because of the continued low birth rates. By use of the utilization and employment data bases described above, population growth and demographic changes are translated into different impacts on requirements for specific types of personnel. Thus, as the population becomes older, the employment of health personnel will also change to maintain the patterns of delivery to the new larger older population group. For example, more nurses and aides must be employed in nursing homes to care for increased numbers of elderly patients.

The data bases described above are particularly useful in demonstrating the variation in health services utilization and employment patterns at a given point in time, such as 1975. However, the health care system is undergoing continued change, and utilization rates for each population group have not and are not likely to remain constant over time. As a result, the model adjusts each rate to account for anticipated changes, based on several factors.

FIGURE 1

OVERVIEW OF THE HEALTH PROFESSIONS REQUIREMENTS MODEL



It is well known that changes in the prices that consumers pay for health services have an impact on their utilization of such services. However, the degree of sensitivity to price changes depends on the particular service sought. For example, most preventive care services are elective, and if prices for such services increase, some consumers may postpone treatment and others may do without these services entirely. On the other hand, most hospital care is provided for serious acute or chronic conditions and, for the most part, is nonelective.

Similarly, the appropriate price in studying consumer behavior in the purchase of health care is not the price charged by the provider but the amount paid out-of-pocket by the consumer. Since private and public health insurance programs finance most hospital care, consumers have relatively little direct expense in this sector. On the other hand, most expenses for pharmaceuticals are not covered by health insurance and the price charged by the provider is very likely to be the full amount paid out of pocket.

In addition to the impact of prices and health insurance, there are a host of other factors that have affected health services utilization over time. Changes in the incidence of illness and conditions, advances in medical technology, and evolving attitudes toward particular types of care--all have had substantial effects which are difficult to quantify explicitly and individually. The procedure adopted in the BHPr requirements model was to assume that these factors will continue into the future, extending the trends of the recent past.

The manner in which all of these trend adjustments are performed is somewhat complex. Data for several years are compiled for each health service on utilization, price, and health insurance payments. Based on studies in the health economics literature, a value for the degree of responsiveness to price is assumed. Then the effects of price and insurance are factored out of each utilization trend. The resulting trend is referred to as a "nonprice" trend, which simply means that it is the residual after price effects have been removed. The nonprice trend adjusts for the combined influence of a number of factors including changes in disease incidence and medical technology. Each of these three variables--price, insurance, and the nonprice trends--is then separately projected into the future.

It is important to keep in mind what is meant by the term "requirements" in the context of the BHPr general personnel requirements projection model. The major goal of this modeling effort is to identify the numbers of personnel that are likely to be needed in future years to provide the pattern of health services that currently exists in the Nation, after adjustment for a few specific changes that are likely to occur. The model is essentially a demand based model and does not provide any information on appropriate or normative "standards" of care. It is obvious that there is considerable heterogeneity in the health care industry. This is evident in all of the areas addressed by the model--utilization, employment, productivity, etc. Persons with the same conditions and demographic characteristics differ substantially in their utilization of health services. Examination of data on the Nation's hospitals, for example, demonstrates a wide range of staffing ratios even for hospitals of similar size, ownership, and teaching status. Similarly, physicians of the same specialty spend varying amounts of time with patients, and there are major differences in the number of patients seen per week.

All of these phenomena can be summarized by statistical distributions and measures. The model typically makes use of averages of these distributions, such as the mean number of dental visits per person per year. Yet the data from which these averages are computed show considerable diversity (i.e., a high standard deviation). The same point can be made about appropriate standards of care. Thus, use of a single specific standard can be misleading because there are and will continue to be a wide range of appropriate standards depending on the criteria set forth in developing these standards. Even "experts" have very different opinions on appropriate care, which are presumably due to differences in the relative importance of specific criteria and the diversity of their personal experiences.

This diversity of opinion becomes even more evident when close substitutes for certain personnel are considered. That is, several types of personnel or combinations of personnel can be used to perform the same tasks while meeting appropriate standards. Registered nurses, licensed practical nurses and nursing aides can and do provide patient care in hospitals, with each hospital exhibiting different combinations of personnel. General practitioners, internists, pediatricians, physician assistants, and nurse practitioners can and do perform some of the same functions in office practice. Thus, the concept of requirements is less meaningful when such close substitutes are considered.

Chapter II

DETAILED PRESENTATION OF THE MODEL

Population

The U.S. population is divided within the model into 40 subgroups (both sexes, five age brackets, and four income categories). Subdivision of the population in this manner is based on the recognition that different population segments are characterized by different utilization rates. The specific age and income "breaks" designated in the model were selected so as to match the available data on population (as reported by the Bureau of the Census) and on utilization (as reported, predominantly, by the National Center for Health Statistics). These are reported for the base year 1975 in table 1.

The population projections used as their starting point the United States population, by age, sex, and income, derived from data reported by the Bureau of the Census for 1970. Similar distributions are less readily derived for the years subsequent to 1970. The complication lies in the fact that the Bureau of the Census does not maintain post-1970 projections by age, sex, and income jointly. The Bureau does, however, provide projections to 1990 for age and sex on the one hand, and for income on the other.

Given the marginal distributions for each year, the next step in the derivation is to allocate those figures to the internal cells of joint distribution matrix. The Division of Health Professions Analysis accomplishes this subdivision through a process based on the use of determinants in which the inner values are calculated so as to preserve the marginal totals for that year, while conforming to the age/sex/income profile which prevailed in 1970.

The outcome of this process is a series of population projections which are then available for use as input to the computer program. These projections show a population that, by 1990, tends to be older and that has higher income than in 1975.

Both tendencies are sharply evident from table 2 which presents projected shifts in the age and income distribution of the population between 1970 and 1990. The percentage of persons under 25 is projected to drop sharply (from 46.3 to 35.4 percent) while the percentage 65 and over is projected to rise (from 9.5 to 12.3 percent). The greatest single increase, however, is noted in the 25 to 44 age bracket; reflecting the post World War II baby boom, the percentage of persons in that bracket is projected to grow from 23.6 percent to 32.9 percent. In 1970, there were about five persons under 25 for every one 65 and over; by 1990, that ratio is predicted to have declined to three to one.

Table 1.

Population in 1975 by age, sex, and family income level

	All Incomes	Under $10000	$10000-$9999	$15000 $14999	$15000 & over
ALL PERSONS	213,032	35,419	49,818	51,427	76,368
Under 14	49,321	6,942	11,902	13,339	17,138
14-24	44,267	7,726	10,339	10,224	15,978
25-44	53,507	4,879	10,821	15,080	22,727
45-64	43,534	5,925	9,741	10,251	17,617
65 & Over	22,403	9,947	7,015	2,533	2,908
MALE					
TOTAL	103,710	14,713	23,494	26,025	39,478
Under 14	25,163	3,554	6,012	6,768	8,829
14-24	22,275	3,687	4,964	5,163	8,461
25-44	26,273	2,002	5,071	7,762	11,438
45-64	20,824	2,017	4,195	5,155	9,457
65 & over	9,175	3,453	3,252	1,177	1,293
FEMALE					
TOTAL	109,322	20,706	26,324	25,402	36,890
Under 14	24,158	3,388	5,890	6,571	8,309
14-24	21,992	4,039	5,375	5,061	7,517
25-44	27,234	2,877	5,750	7,318	11,289
45-64	22,710	3,908	5,546	5,096	8,160
65 & over	13,228	6,494	3,763	1,356	1,615

Source: DHPA calculations.

Table 2.

Projected shifts in age and income distribution, 1970-1990

	Percent Distribution by Year*				
	1970	1975	1980	1985	1990
AGE:					
Under 14	26.8	23.2	20.5	19.5	19.4
14-24	19.5	20.8	20.5	18.5	16.0
25-44	23.6	25.1	28.1	31.1	32.9
45-64	20.6	20.4	19.8	19.2	19.4
65+	9.5	10.5	11.1	11.7	12.3
	100.0	100.0	100.0	100.0	100.0
INCOME:**					
Under $5,000	19.9	16.6	11.6	9.9	8.6
$5,000-$9,999	30.7	23.4	20.2	16.9	11.6
$10,000-$14,999	26.4	24.1	24.3	21.2	18.7
$15,000 and over	23.0	35.8	43.7	51.9	58.1
	100.0	100.0	100.0	100.0	100.0

*Columns may not add due to rounding.
**In 1970 dollars.

Source: DHPA population projections using methods and data described in the text.

The projected shift in income distribution is even more dramatic. As shown in table 2, the percentage of individuals whose family income, measured in 1970 dollars, lies below $10,000 is projected to shrink from 50.6 percent to 20.2 percent while the percentage of those with family incomes of $15,000 or greater is projected to grow from 23.0 percent to 58.1 percent--a complete reversal of the percentages in the below $10,000 and above $15,000 groups respectively.

The slight predominance of females to males which prevailed in 1975 (51.3 percent) is projected to be extended to 1990 (51.5 percent).

Utilization

Utilization in the base year (1975) is expressed in the form of per capita utilization rates for each of 40 population segments with respect to each of 20 forms of health care. The 40 population segments are defined by the age-sex-income matrix shown above in table 1. The 20 forms of health care are listed in table 3. For completeness, both direct patient care and indirect (or noncare) activities are included.

The interaction of 40 population segments with 20 forms of health care activity produces a total of 800 separate utilization rates which must be specified. These are typically actual rates based on past experience. Alternatively, the user may wish to explore the consequences of hypothetical utilizaton rates. In either case, they are specified as input; they are not explicitly calculated within the model.

Table 4 presents the utilization rates for the base year 1975. Data were gathered from a variety of sources to estimate these utilization rates. However, the Health Interview Survey and the Hospital Discharge Survey, both of which are conducted by the National Center for Health Statistics, provided most of the data. The projected utilization in years subsequent to 1975 is obtained by simply applying the 1975 per capita utilization rates to the projected U.S. population by age, sex, and income, in those years.

Health Personnel Matrix

The task of forecasting health personnel requirements is complicated by the fact that most groups of practitioners provide more than one type of care. General practitioners provide pediatric and ob-gyn care; pediatricians treat some adults; obstetrician-gynecologists have a few male patients.

Table 5 presents the 28 categories of health personnel contained in the model for the base year. A full description of the Nation's health personnel requirements involves not only the numbers and types of personnel available but also the forms of care in which they are engaged. The BHPr general requirements model accomplishes this through the personnel matrix introduced in table 6. The entries in that matrix denote the number of practitioners (of a given type) engaged in rendering care (of a given form within a given setting). Detailed discussion of this matrix appears in appendix I.

Table 3.

Health care categories

Setting	Form of Care
Medical Office:	General Care
	Pediatric Care
	Obstetric-Gynecological Care
	Psychiatric Care
	Vision Care
	Other Medical Office Care
Short-Term Hospital:	Outpatient Care
	Surgical Care
	Medical Care
Long-Term Hospital:	Psychiatric Care
	Other Long-Term Hospital Care
Additional Health Care Settings:	Nursing Home Care
	Dental Care
	Pharmacy Services
	Laboratory Services
	Optometric Care
	Podiatric Care
	Other Patient Care, not elsewhere specified
Nonpatient care Settings:	Administration, Teaching and Research
	Veterinarian Services

Table 4.

Utilization rates by population category and by type of care

Population Age, Sex, and Family Income	Medical Office: General Care	Pediatric Care	Ob-Gyn Care	Psychiatric Care	Other Care	Short-Term Hospital: Outpatient Care	Surgical Care
Income Under $5000							
Male							
Under 14	3.1658	1.2767			.6328	.5532	.0398
14-24	2.1425	.0293		.0289	1.0094	.3444	.0363
25-44	3.7202		.0270	.3343	2.1260	1.7019	.0552
45-64	4.1271	.0239		.1155	1.7225	.8141	.0836
65 & Over	4.0878			.0191	1.3774	.5257	.1132
Female							
Under 14	2.7652	1.6267	.0264		.6438	.5423	.0328
14-24	4.0259	.0495	1.0884	.1416	.9361	.8770	.1518
25-44	4.6231	.0492	.9140	.3342	1.5026	1.0170	.1609
45-64	5.7642		.2287	.1834	1.8506	.7069	.0887
65 & Over	5.1745	.0073	.1009	.0136	1.1413	.2138	.0857
Income $5000-9999							
Male							
Under 14	2.1999	1.4319	.0319	.0101	.6311	.5197	.0359
14-24	2.5307	.0786		.0585	.7547	.4578	.0483
25-44	1.7948		.0489	.0688	.9465	.3188	.0400
45-64	3.8789		.0116	.0257	1.3315	.6071	.0837
65 & Over	5.1792			.0629	1.6315	.8273	.1278
Female							
Under 14	1.9695	1.6259			.4273	.4707	.0257
14-24	3.0999	.0784	1.6709	.0529	.7405	.6388	.1588
25-44	3.9169	.0435	1.3986	.1699	1.2601	.7667	.1693
45-64	4.8997		.1924	.0360	1.0741	.5539	.0837
65 & Over	5.1712		.0876	.0754	1.2931	.2991	.0848

Table 4. (continued)

Population Age, Sex, and Family Income	Medical Office: General Care	Medical Office: Pediatric Care	Medical Office: Ob-Gyn Care	Medical Office: Psychiatric Care	Short-Term Hospital: Other Care	Short-Term Hospital: Outpatient Care	Short-Term Hospital: Surgical Care
Income $10000-14999							
Male							
Under 14	2.2505	2.2060	.0228	.0078	.4270	.3180	.0424
14-24	1.8593	.0527	.0097		.9111	.1990	.0347
25-44	2.1817	.0060	.0289	.0592	.9982	.2153	.0457
45-64	3.0054		.0186	.0108	1.3335	.7028	.0740
65 & Over	5.0886				1.2814	.5472	.1063
Income $10000-14999							
Female							
Under 14	1.6192	2.0807	.0153	.0182	.4543	.2820	.0289
14-24	3.0232	.1279	1.1763	.0212	.7207	.3069	.1220
25-44	3.5083	.0240	1.5604	.0434	.9818	.4664	.1467
45-64	4.6627		.4073	.0399	1.1917	.5324	.0985
65 & Over	5.0806		.0401		1.8805	.6909	.0845
Income $15000 & Over							
Male							
Under 14	1.8938	2.6789	.0052		.6572	.2122	.0389
14-24	2.2437	.2234	.0163	.0557	.8604	.2270	.0370
25-44	2.5291	.0079	.0243	.0689	.9564	.1622	.0383
45-64	3.2291	.0048	.0105	.1000	1.1093	.2800	.0659
65 & Over	4.9473			.0495	1.4865	.6363	.0774
Female							
Under 14	1.5695	2.0782	.0106	.0674	.5041	.2104	.0293
14-24	2.7089	.2438	.8316	.0569	.8887	.1921	.0727
25-44	3.3537	.0425	1.5768	.1916	1.1147	.3406	.1342
45-64	3.7725	.0336	.5836	.1112	1.4434	.4505	.0885
65 & Over	4.3464		.0702	.0715	.6618	.1868	.1108

Table 4. (continued)

Population Age, Sex, and Family Income	Short-Term -Hospital- Medical Care	Long-Term ------Hospital------- Psychiatric Care	Nursing Home Care	Vision Care	Dental Care	Pharmacy Services	Optometric Care	Podiatric Care
Income Under $5000								
Male								
Under 14	.0725	.0006		.0399	.7964	3.1358	.0419	.0113
14-24	.0296	.0032		.0854	1.3485	2.3647	.1322	.0070
25-44	.0875	.0048		.0354	1.3210	4.1008	.0913	.0117
45-64	.2021	.0036	.0025	.0965	1.2758	10.9533	.1019	.0139
65 & Over	.1556	.0019	.0290	.1365	.6597	10.9902	.1161	.0329
Female								
Under 14	.0439	.0003		.0550	.7752	2.9151	.0630	.0085
14-24	.0665	.0017		.1055	1.3987	5.7524	.1391	.0117
25-44	.1175	.0032		.0849	1.3238	8.7136	.0995	.0250
45-64	.1407	.0027	.0027	.3311	1.2781	12.5252	.1665	.0394
65 & Over	.1483	.0012	.0526	.2043	.6897	14.2299	.1214	.0663
Income $5000-9999								
Male								
Under 14	.0516	.0006		.0627	.8823	3.0999	.0526	.0067
14-24	.0266	.0032		.1207	1.3808	1.9041	.1095	.0097
25-44	.0533	.0048		.1055	1.0039	3.2832	.0898	.0090
45-64	.1227	.0036	.0025	.0917	1.1664	7.3237	.1506	.0194
65 & Over	.1296	.0019	.0290	.2978	1.4904	10.9416	.1409	.0491
Female								
Under 14	.0434	.0003		.0394	.9564	2.9375	.0566	.0051
14-24	.0545	.0017		.0591	1.9562	4.9203	.1444	.0093
25-44	.0751	.0032		.0669	1.3964	6.8197	.1301	.0125
45-64	.1001	.0027	.0027	.1310	1.5439	9.7670	.1603	.0484
65 & Over	.1219	.0012	.0526	.1874	1.0857	13.1549	.1540	.1016

Table 4. (continued)

Population Age, Sex, and Family Income	Short-Term -Hospital- Medical Care	Long-Term ------Hospital------- Psychiatric Care	Nursing Care	Vision Care	Dental Care	Pharmacy Services	Optometric Care	Podiatric Care
Income 10000-14999								
Male								
Under 14	.0327	.0006		.0270	1.3700	3.1669	.0605	.0151
14-24	.0332	.0032		.0403	1.3070	1.9694	.1159	.0101
25-44	.0414	.0048		.0780	1.2391	2.9413	.0992	.0110
45-64	.0764	.0036	.0025	.1364	1.2029	5.7852	.1483	.0182
65 & Over	.1940	.0019	.0290	.1810	1.8345	9.0405	.1736	.0422
Income 10000-14999								
Female								
Under 14	.0346	.0003		.0353	1.4055	3.2029	.0766	.0147
14-24	.0387	.0017		.0409	2.3071	4.8652	.1725	.0112
25-44	.0567	.0032		.1232	1.8999	7.2595	.1416	.0097
45-64	.0775	.0027	.0027	.1473	1.9393	8.3985	.2126	.0485
65 & Over	.1403	.0012	.0526	.2493	.9246	12.7444	.1777	.0981
Income $15000 & Over								
Male								
Under 14	.0337	.0006		.0641	1.8644	3.6374	.0809	.0100
14-24	.0250	.0032		.0712	2.2018	2.3427	.1204	.0104
25-44	.0303	.0048		.0683	1.8250	3.4810	.1255	.0142
45-64	.0697	.0036	.0025	.1656	1.9341	5.2895	.1782	.0285
65 & Over	.1002	.0019	.0290	.1163	2.0896	10.3168	.1675	.0466
Female								
Under 14	.0186	.0003		.1041	1.9547	3.4837	.0822	.0081
14-24	.0278	.0017		.0838	2.6963	4.1653	.1901	.0136
25-44	.0487	.0032		.1324	2.0893	6.9528	.1573	.0279
45-64	.0610	.0027	.0027	.2245	2.5072	7.8923	.2186	.0797
65 & Over	.1168	.0012	.0526	.4777	1.7030	10.8600	.1341	.1194

Table 5.

Health personnel types

	Estimated Supply in 1975
Physicians (MD):	
General[1]	116,430
Pediatric	21,746
Ob/Gyn	21,731
Ophthalmology	11,129
Psychiatry	26,502
Surgery[2]	76,017
Secondary Specialist[3]	48,322
Noncare Specialist[4]	18,403
Physicians (DO)	14,532
Dentists	114,999
Optometrists	20,101
Podiatrists	7,300
Pharmacists	122,500
Veterinarians	31,060
Registered Nurses	961,000
Physician Extenders	7,854
Allied Health Personnel:	
Administrative Personnel	682,098
Medical Library Personnel	10,701
Medical Records Personnel	64,001
Clinical Laboratory Personnel	182,000
Dietary Services Personnel	75,001
Radiologic Services Personnel	105,001
Therapy Personnel, not elsewhere specified	165,499
General Medical Personnel[5]	86,527
Nursing Care Personnel (other than RNs)	1,468,999
Vision Care Personnel (other than ophthalmologists and optometrists)	35,000
Pharmacy Assistants and Aides	100,333
Dental Hygienists, Assistants, and Technicians	175,801

1/ Includes general and family practice, internal medicine, and "specialty unspecified" (presumed to provide predominantly primary care).

2/ Includes general surgery, neurological surgery, orthopedic surgery, otolaryngology, plastic surgery, colon and rectal surgery, thoracic surgery, urology, and anesthesiology.

3/ Includes allergy, cardiovascular diseases, dermatology, gastroenterology, pediatric allergy, pediatric cardiology, pulmonary diseases, radiology, diagnostic radiology, therapeutic radiology, neurology, physical medicine and rehabilitation, and "other specialties.

4/ Includes occupational medicine, general preventive medicine, public health, aerospace medicine, pathology, and forensic pathology.

5/ Includes ambulance attendants, biomedical engineers and technicians, health educators, EKG and EEG technicians, orthotists, prosthetists, and surgical aides.

Table 6. General estimated health manpower by type and type of occupation: 1975

	TOTAL	MEDICAL OFFICE					SHORT-TERM HOSP			LONG-TERM HOSP	
		GENERAL CARE 01	PEDIATRIC CARE 02	OB-GYN CARE 03	PSYCH CARE 04	OTHER CARE 05	OUT PT. CARE 06	SURG CARE 07	MEDICAL CARE 08	PSYCH CARE 09	OTHER CARE 10
ALL MANPOWER TYPES	4770587	150891	53829	45748	20673	236159	196684	892450	876648	375832	154352
PHYSICIANS (MD)	340280	46493	21453	16255	15080	76406	8481	63701	35680	9334	3314
GENERAL	116430	36476	9392	2895	1081	26995	5660	1351	21292	3103	1476
PEDIATRIC	21746	568	12061			271	638	49	6179		131
OBSTETRICS-GYN	21731	2634		12964	79			5156			
OPHTHALMOLOGY	11129							1991			
PSYCHIATRY	26502				13857		1746		1392	6231	
SURGERY	76017	3516		396	63	24003		45289			
SECONDARY SPECIALIST	48322	3299				25137	437	4374	6124		1707
NONCARE SPECIALIST	18403							5491	693		
PHYSICIANS (DO)	14532	11072	47	47	35	464	312	254	1210		166
DENTISTS	114999							3639		2589	523
OPTOMETRISTS	20101										
PODIATRISTS	7300						196	239			
PHARMACISTS	122500						5697	2848	2848	1644	333
VETERINARIANS	31060										
REGISTERED NURSES	961000	19964	8905	8611	619	27633	34629	271843	270689	33912	15595
PHYSICIAN EXTENDER	7854	1392	375	142		413	1421	636	637	147	71
ALLIED HEALTH MANPOWER	3150961	71970	23049	20693	4939	131243	145948	549290	565584	328206	134350
ADMINISTRATION	682098	52034	17782	16176	4718	83780	39668	106012	106012	82242	23332
MEDICAL LIBRARIAN	10701						879	1757	1757	1014	1014
MEDICAL RECORD	64001						9105	18210	18210	8490	2257
CLINICAL LAB	182000	8601	1648	1245	17	14560	23088	46176	46176	7735	7735
DIETARY	75001							20027	20027	6223	2872
RADIOLOGIC	105001	3129	538	413		24471	10752	21504	21504	3360	3360
THERAPY	165499						10498	20995	20995	27216	10627
GENERAL MEDICAL	86527					642	6716	7337	24021	2727	6513
NURSING CARE	1468999	8206	3081	2859	204	7790	42185	301382	301382	183467	72129
VISION CARE	35000										
PHARMACY	100333						2667	5500	5500	1500	1500
DENTAL CARE	175801						390	390		4232	3011
HOSPITAL SUPPORT											

Table 6. (continued)

	OTHER CARE				OTHER					
	NURSING HOME 11	VISION CARE 12	DENTAL CARE 13	VET CARE 14	OTHER CARE 15	LAB SERV 16	PHARM SERV 17	NON-CARE ACT 18	OPT. CARE 19	POD. CARE 20
ALL MANPOWER TYPES	546716	55351	303437	29010	438685	53597	181989	117765	28401	12370
PHYSICIANS (MD)	594	8820			2611	4309		27749		
GENERAL	594							6115		
PEDIATRIC								1849		
OBSTETRICS-GYN								898		
OPHTHALMOLOGY		8820						318		
PSYCHIATRY								3276		
SURGERY								2750		
SECONDARY SPECIALIST								7244		
NONCARE SPECIALIST					2611	4309		5299		
PHYSICIANS (DO)		24						901		
DENTISTS			104338					3910		
OPTOMETRISTS								400	19701	
PODIATRISTS	458							37		6370
PHARMACISTS	547						98656	9927		
VETERINARIANS				29010				2050		
REGISTERED NURSES	67751				159622			41227		
PHYSICIAN EXTENDER					2600			20		
ALLIED HEALTH MANPOWER	477366	46507	199099		273852	49288	83333	31544	8700	6000
ADMINISTRATION	49508	11507	31321		46306				8700	3000
MEDICAL LIBRARIAN								4280		
MEDICAL RECORD	3623				4106					
CLINICAL LAB						25019				
DIETARY	14362				9894			1596		
RADIOLOGIC						15970				
THERAPY	26568				48600					
GENERAL MEDICAL					1604	8299		25668		3000
NURSING CARE	382972				163342					
VISION CARE		35000								
PHARMACY	333						83333			
DENTAL CARE			167778							
HOSPITAL SUPPORT										

The manner in which the model makes use of the utilization and personnel inputs defined on the preceding pages is as follows:

- For each of the twenty separate health care categories, the program computes the ratio of the projected utilization of that form of care in year t to the utilization experienced in the base year. Symbolically, that ratio is simply:

$$R_j(t) = \frac{\Sigma N_i(t) * U_{ij}(o)}{\Sigma N_i(o) * U_{ij}(o)}$$

where $N_i(t)$ denotes the projected population of the i^{th} population segment in year t, $N_i(0)$ denotes the actual population of that segment in the given base year, and $U_j(0)$ denotes the corresponding (base year) per capita utilization rate. The summation, as before, is performed over all forty population segments.

As stated, up to twenty values of R(t) are calculated, one for each separate form of care. Values of R(t) greater than 1.0 denote a projected increase in care utilization; values less than 1.0 denote a projected decrease.

- The value of R(t) applicable to the jth care category is then multiplied by the number of practitioners engaged in rendering that form of care in 1975, to arrive at the corresponding projected personnel requirement for year t. Expressed symbolically:

$$M_{jk}(t) = R_j(t) * M_{jk}(0)$$

where: $M_{jk}(t)$ = The projected number of units of personnel type k required to administer health care activity j in year t.

$M_{jk}(0)$ = The estimated number of units of personnel type k actually engaged in administering health care activity j in the given base year (1975).

$R_j(t)$ = The utilization growth factor (see above) projected for the health care activity j between 1975 and year t.

A key feature of this formulation is that the utilization growth factor, $R_j(t)$, is applied uniformly to all personnel types engaged in the jth form of care, i.e., if the utilization of a given form of care grows by 10%, so do all personnel requirements associated with that form of care.

- The values of $M_{jk}(t)$ thus derived are then summed across care categories to arrive at the total number of units of personnel required for each separate personnel type. An example of these calculations, carried out for the personnel category "pediatricians," is shown in table 7.

Table 7.

Illustrative computation of personnel requirements

1. According to the calculations presented in appendix I, the nation's pediatricians were involved in 1975 in the following forms of health care activity, in the numbers shown:

		Number of Pediatricians Engaged in This Activity (1975)
Medical Office:	General Care	568
	Pediatric Care	12,061
	Other Care	271
Short-Term Hospital:	Outpatient Care	638
	Surgical Care	49
	Medical Care	6,179
Long-Term Hospital:	Other Care	131
Nonpatient Care Settings		1,849
	TOTAL	21,746

2. Between 1975 and 1990, utilization of each of the foregoing forms of care will undergo the following growth (or reduction):

		Projected Utilization Growth, by 1990 (1975=100)
Medical Office:	General Care	108.9
	Pediatric Care	101.1
	Other Care	111.0
Short-Term Hospital:	Outpatient Care	95.6
	Surgical Care	110.9
	Medical Care	103.3
Long-Term Hospital:	Other care	110.5
Nonpatient Care Settings		110.5

Table 7. (continued)

3. Applying these projected growth factors to be corresponding 1975 supply of pediatricians, the following table of projected 1990 personnel requirements is produced:

	(A) No. of Pediatricians Engaged in This Activity(1975)	(B) Projected Utilization Growth by 1990 (1975-100)	(C) Projected 1990 Personnel Requirements (A) X (B) X .01
Medical Office:			
General Care	568	108.9	619
Pediatric Care	12,061	101.1	12,194
Other Care	271	111.0	301
Short-Term Hospital:			
Outpatient Care	638	95.6	610
Surgical Care	49	110.9	54
Medical Care	6,179	103.3	6,383
Long-Term Hospital:			
Other Care	131	110.5	145
Nonpatient Care Settings	1,849	110.5	2,043
		TOTAL	22,349

The striking changes in the age and income composition of the population result in similar changes in utilization patterns. The trends noted above imply that those forms of care more heavily used by the elderly and by those with higher incomes will grow more rapidly than those forms favored by the young and by the poor, and that the personnel requirements most closely associated with those forms of care will also experience a differentially higher rate of growth. That this is indeed the case is seen in table 8, in which the greatest growth projections are noted for nursing home care and podiatric care (both utilized more heavily by the elderly) and for psychiatric, vision, and dental care (each with some element of deferrability and therefore favored by those with higher incomes). Conversely, the lowest growth projections are for outpatient hospital care (a form favored by the poor) and for pediatric care, involving the young.

Price and Health Insurance Adjustments

As stated above, the basic configuration examines the changes in personnel requirements associated solely with the population growth and shifts in age/sex/income distribution. An additional feature is introduced to drive the model closer to reality. That feature is the ability to account for the interaction between demand (or utilization) and price, and to relate that interaction to both past and future changes in utilization.

Specifically, the PRICE submodel examines the historical trend in utilization and separates that trend into two components: that which is presumably a result of consumer response to changes in the price of health care and that which is seemingly unrelated to price.

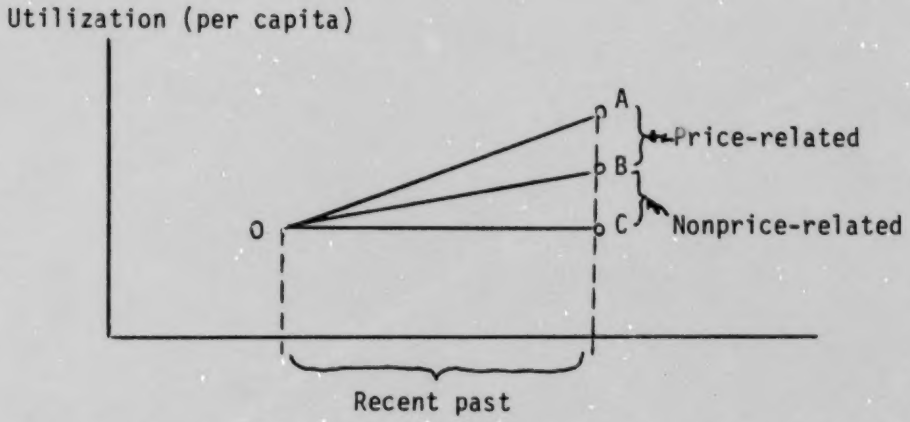


Figure 2. Components of change in per capita utilization

Over the years, the price of health care relative to the Consumer Price Index has risen for some forms of care and declined for others. In almost all instances, however, the net price to the consumer declined owing to increased private and public health insurance. For those forms of health care for which the net price to the consumer has declined, per capita utilization will

Table 8.

Projected utilization growth factors
attributable to demographic effects: 1975-1990

		Projected Growth (1975 = 100.0)
Medical Office:	General Care	108.9
	Pediatric Care	101.1
	Ob-Gyn Care	120.5
	Psychiatric Care	124.7
	Vision Care	123.8
	Other Care	111.0
Short-Term Hospital:	Outpatient Care	95.6
	Surgical Care	110.9
	Medical Care	103.3
Long-Term Hospital:	Psychiatric Care	118.9
	Other Care	110.5*
Additional Health Care Settings:	Nursing Home Care	127.3
	Dental Care	121.6
	Pharmacy Services	111.7
	Laboratory Services	110.5*
	Optometric Care	116.4
	Podiatric Care	127.2
	Other Care	110.5*
Nonpatient care Settings:	Administration, Teaching and Research	110.5*
	Veterinarian Services	110.5*

*Age-, sex-, and income-specific utilization rates are either inappropriate or unavailable for these categories. The growth factor shown (110.5) is that attributable solely to the overall growth of the population. Nonpatient care activities are not assumed to be directly influenced by population factors.

Source: DHPA projections using the BHPr personnel requirements model.

presumably have tended to grow. In the diagram, the line segment AB reflects the consumer response to declines in the net price of health care; the line segment BC reflects the impact of all other (i.e., nonprice-related) factors such as increased accessibility, increased consumer awareness, changes in consumer taste and preference, etc.

Utilization Trend Analysis--Examining the Past

The first step is to define the period of time for which the analysis is to be conducted. Because of the change in health care financing (and therefore utilization) which took place with the advent of Medicare and Medicaid, the period of analysis was defined as the period beginning in 1966 and extending through the latest year for which suitable data are available (currently 1976).

We denote the observed per capita utilization as U. The value for each year is made up of two parts: a price-related component, F_p, and a nonprice-related component, F_{np}. The first of these components relates to that portion of the change in utilization which is strictly a result of changes in the price of a given form of health care, insofar as changes in price affect consumer decisions to seek that form of care. The second component relates to all other influences combined; those influences include such factors as changes in the accessibility of care, changes in consumer taste and preference, changes in the demographic makeup of the population, and so on. Other nonprice factors which may affect utilization include changes in medical technology, environmental changes, and changes in disease prevalence and incidence. No attempt is made, in the trend analysis, to treat these factors separately; all are merged into the single nonprice-related component F_{np}.

We may therefore write the expression as follows:

$$U = F_p \times F_{np}$$

Of these three quantities, two are known (U and F_p) and the model presumes - as we will shortly see - to estimate the third (F_{np}):

$$F_{np} = \frac{U}{F_p}$$

Continuing in this fashion, values of F_{np} may be derived for each year for which there are data. Once those values are known, their trend can be extrapolated ahead to future years and used as a basis for projecting how utilization might behave based on nonprice-related factors alone. Before this can be done, however, the price-related component, F_p, must be identified and factored out.

Estimating F_p. - It is assumed that there exists for each year and for each form of care an average net price to the consumer (NPC), and that as price fluctuates from year to year, so too will demand.[7/]

7/ In the price-oriented discussion which follows, "utilization" and "demand" are used interchangeably.

The model defines the net price to the consumer as the product of two factors:

P_x - The ratio of the Consumer Price Index for a given form of health care (x) to the Consumer Price Index for all items combined, i.e.:

$$P_x = \frac{CPI_x}{CPI_{all}}$$

I_x - The average coinsurance rate applicable to the given form of health care. ("Coinsurance rate" is defined as the percentage of the total cost, for that form of care, which the consumer pays out of his own pocket.)

The first of these quantities, P_x, is available from the Bureau of Labor Statistics for the following generic forms of care:

- physician office services
- short-term hospital services
- dental office services
- community pharmacy services

The second quantity, I_x, is a composite of several factors: (a) the percentage of persons who hold health insurance involving the form of care in question, (b) the deductible or "first dollar" amounts which the holders of such insurance are obliged to pay, and (c) the copayment percentage (sometimes called "marginal coinsurance rate") applicable once the deductible has been satisfied. Since factors (b) and (c) can vary, sometimes significantly, the notion of an "average" coinsurance rate, integrated across all segments of the population and all policy holders, has been adopted.

Values of P_x, I_x, and their product (Net Price to the Consumer), as developed by the Division of Health Professions Analysis, are shown in Table 9. For all four forms of care - i.e., physician office, short-term hospital, dental office, and community pharmacy - the net price to the consumer is observed to have steadily declined between 1966 and 1976. The declines are plotted in figure 3.[8,9]

8/ The reader is reminded that Net Price to the Consumer is an index - the product of P_x (a ratio) and I_x (a fraction). It has no dimensional significance and can only be viewed in terms of its changes from year to year.

9/ Since the values of P_x and I_x apply to the population as a whole rather than to specific population segments, the utilization trend analysis makes no age, sex, or income distinctions.

Table 9.

Values of price-related variables for four forms of health care, 1966-1976

	Medical Office			Short-term Hospital			Dental Office			Community Pharmacy		
	P_x	I_x	NPC	P_x	I_x	NPC	P_x	I_x	NPC	P_x	I_x	NPC
1966	0.961	0.621	0.597	0.864	0.184	0.159	0.979	NA	-	1.034	0.939	0.971
1967	1.000	0.556	0.556	1.000	0.123	0.123	1.000	0.966	0.966	1.000	0.929	0.929
1968	1.013	0.480	0.486	1.086	0.104	0.113	1.012	0.947	0.959	0.962	0.920	0.885
1969	1.028	0.457	0.470	1.165	0.104	0.121	1.028	0.944	0.971	0.923	0.910	0.840
1970	1.044	0.449	0.269	1.237	0.123	0.152	1.027	0.936	0.961	0.891	0.900	0.802
1971	1.070	0.438	0.469	1.326	0.102	0.135	1.047	0.928	0.972	0.869	0.891	0.774
1972	1.068	0.430	0.459	1.309	0.088	0.115	1.056	0.920	0.971	0.843	0.881	0.742
1973	1.038	0.405	0.421	1.276	0.100	0.128	1.025	0.907	0.929	0.796	0.872	0.694
1974	1.022	0.399	0.408	1.253	0.122	0.153	0.994	0.868	0.863	0.742	0.861	0.639
1975	1.051	0.390	0.410	1.319	0.098	0.129	1.004	0.858	0.862	0.737	0.850	0.626
1976	1.106	0.387	0.428	1.430	0.089	0.127	1.012	0.795	0.804	0.739	0.844	0.624

P_x = Ratio of CPI for indicated form of care to CPI for all items combined.

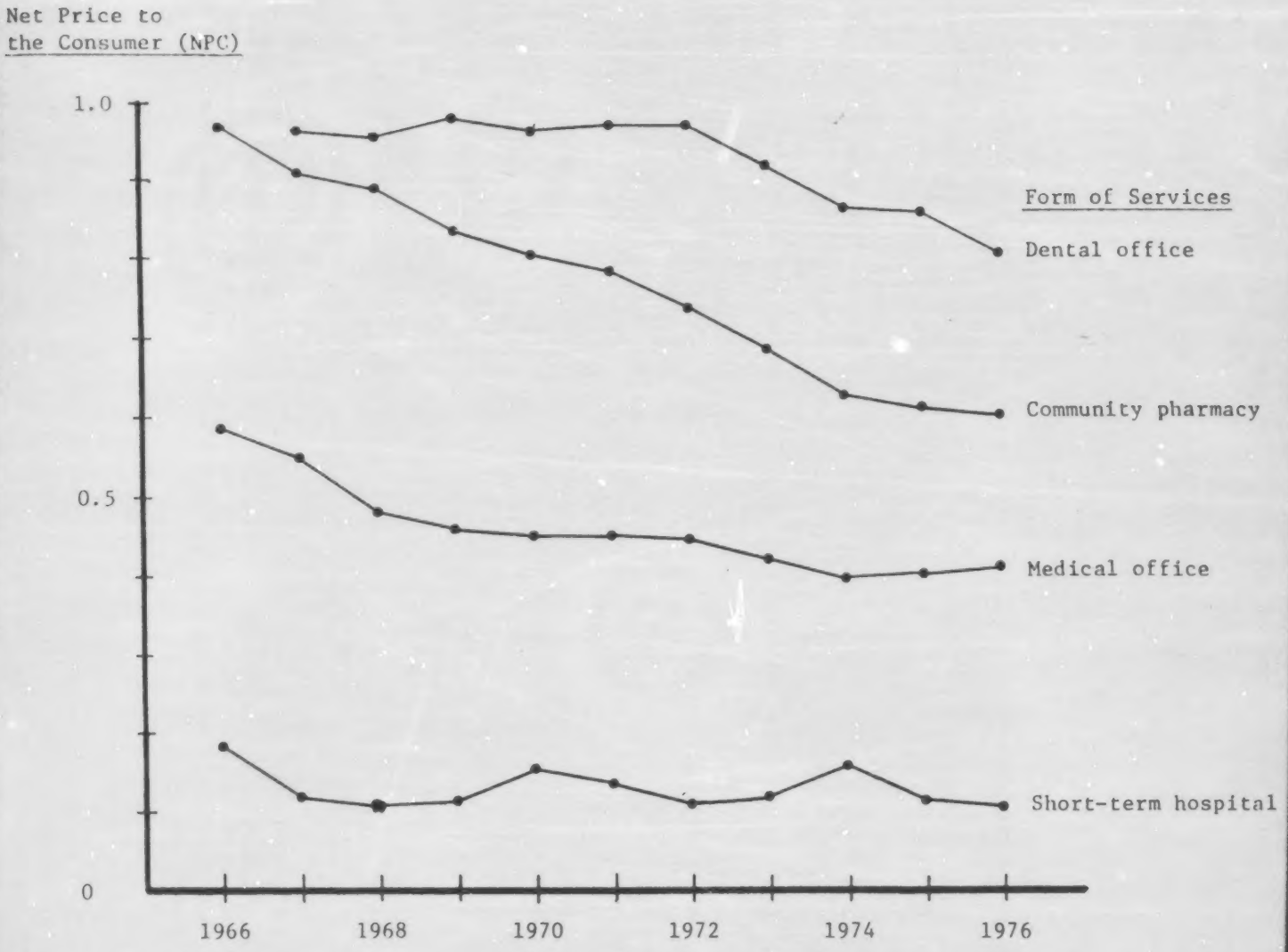
I_x = Average coinsurance rate applicable to indicated form of care.

NPC = Net price to consumer, defined as the product of P_x times I_x.

(NA = Not Available)

Source: Division of Health Professions Analysis estimates.

FIGURE 3: NET PRICE TO THE CONSUMER, FOUR FORMS OF HEALTH CARE, 1966-1976



Economists use mathematical formulas to quantify the relationship between consumer demand and the factors which determine this demand. Demand is usually represented by the quantities of the goods and services actually produced and consumed in a given year. This procedure generally provides a reasonable proxy for demand, unless the price of the good or service is constrained by factors unrelated to supply and demand, such as price controls and rationing during war time.

Demand equations typically relate the quantity demanded to the price of the good, the prices of related goods, and consumer income. By applying econometric techniques to historical data it is possible to determine the degree to which each factor influences demand. For example, the responsiveness of consumer demand to changes in the price of the good is referred to as the (own) price elasticity of demand. This is defined as the percentage change in quantity demanded resulting from a one percent increase in the price of the good. The larger the absolute value of the elasticity of demand, the greater the responsiveness to changes in price.

Values for the price elasticity of demand were assumed using studies conducted by health economists. These values are presented in table 10. The responsiveness of most health services to demand is assumed to be low, although larger values of the price elasticity of demand have been observed for some usually elective services such as dental care. The model is capable of accepting various types of demand equations. Linear, double log, and semi log functions are frequently used in the economics literature.

Once the shape of the price elasticity curve and the value of the associated elasticity coefficient have been established, price-related adjustment factors (F_p) are calculated. Dividing each year's overall utilization by the appropriate price-related adjustment factor for the year in question produces the nonprice-related component of utilization for that year--i.e., the utilization which would have resulted had price not been a factor (or had price remained the same). Four such series are derived, one for each form of care. The resulting series are plotted in figures 4 through 7 respectively, for both high and low values of elasticity.[10/]

Projecting the Future

Once the preceding process has been completed, an ordinary (linear) least squares regression is fitted to the nonprice-related utilization figures. The resulting straight line is then extrapolated ahead to the year or years for which requirements projections are desired. The next step in the projection process is to adjust the extrapolated values, either upward or downward, to reflect the impact of price in the years ahead. This is accomplished in the following manner:

10/ The utilization data on which these exhibits were based were obtained by DHPA from the following sources: physician and dental office services from NCHS Health Interview Survey reports; short-term hospital services from admissions to non-Federal short-term general and other special hospitals as reported in the Hospital Guide Issue, Hospitals, American Hospital Association; and community pharmacy services from data on new and refill prescription acquisitions obtained through personal correspondence.

Table 10.

Assumed elasticity coefficients, four forms of health care

Health Service Category	Price Elasticity of Demand	
	Low Series	High Series
Medical office services	-0.14	-0.30
Hospital services	-0.08	-0.20
Dental services	-0.16	-1.00
Pharmacy services	-0.07	-0.15

Source: The basis for these assignments is provided in James M. Cultice and Roger B. Cole, The Impact of Comprehensive National Health Insurance on Demand for Health Manpower, DHEW Publication No. (HRA) 77-102, July 1976.

FIGURE 4: PER CAPITA UTILIZATION OF PHYSICIAN OFFICE SERVICES, 1966-1976

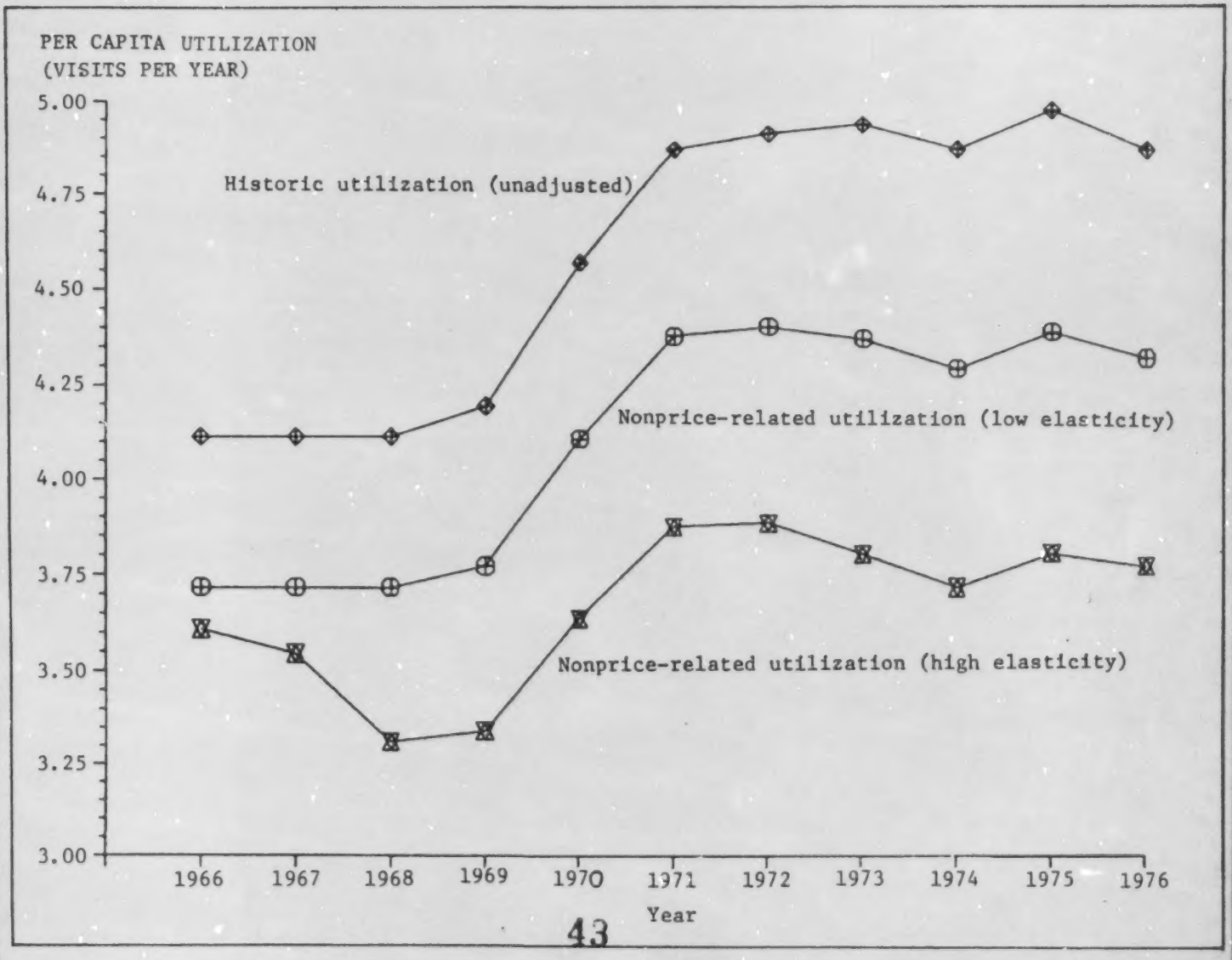


FIGURE 5: PER CAPITA UTILIZATION OF SHORT-TERM HOSPITAL SERVICES, 1966-1976

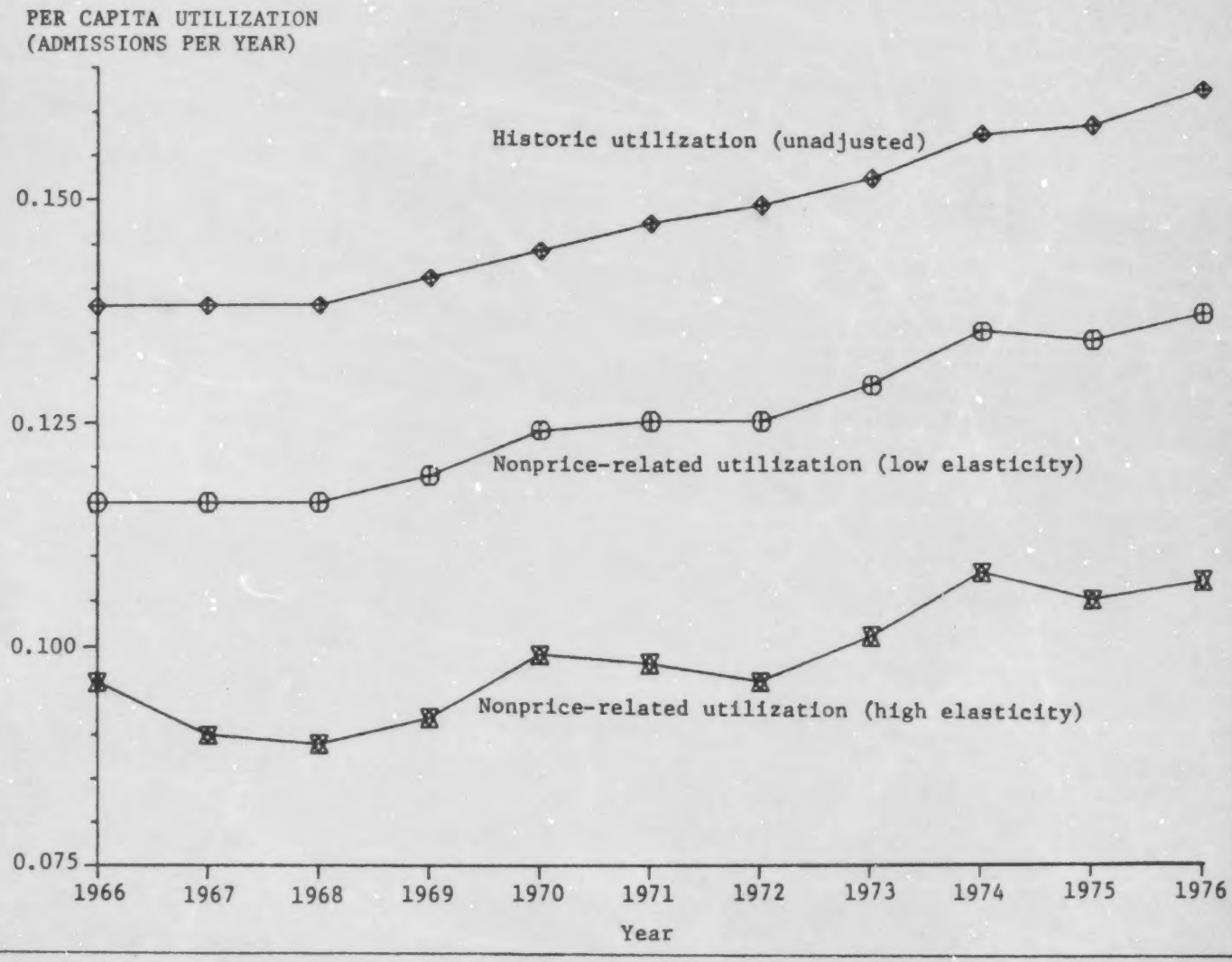


FIGURE 6: PER CAPITA UTILIZATION OF DENTAL OFFICE SERVICES, 1968-1976

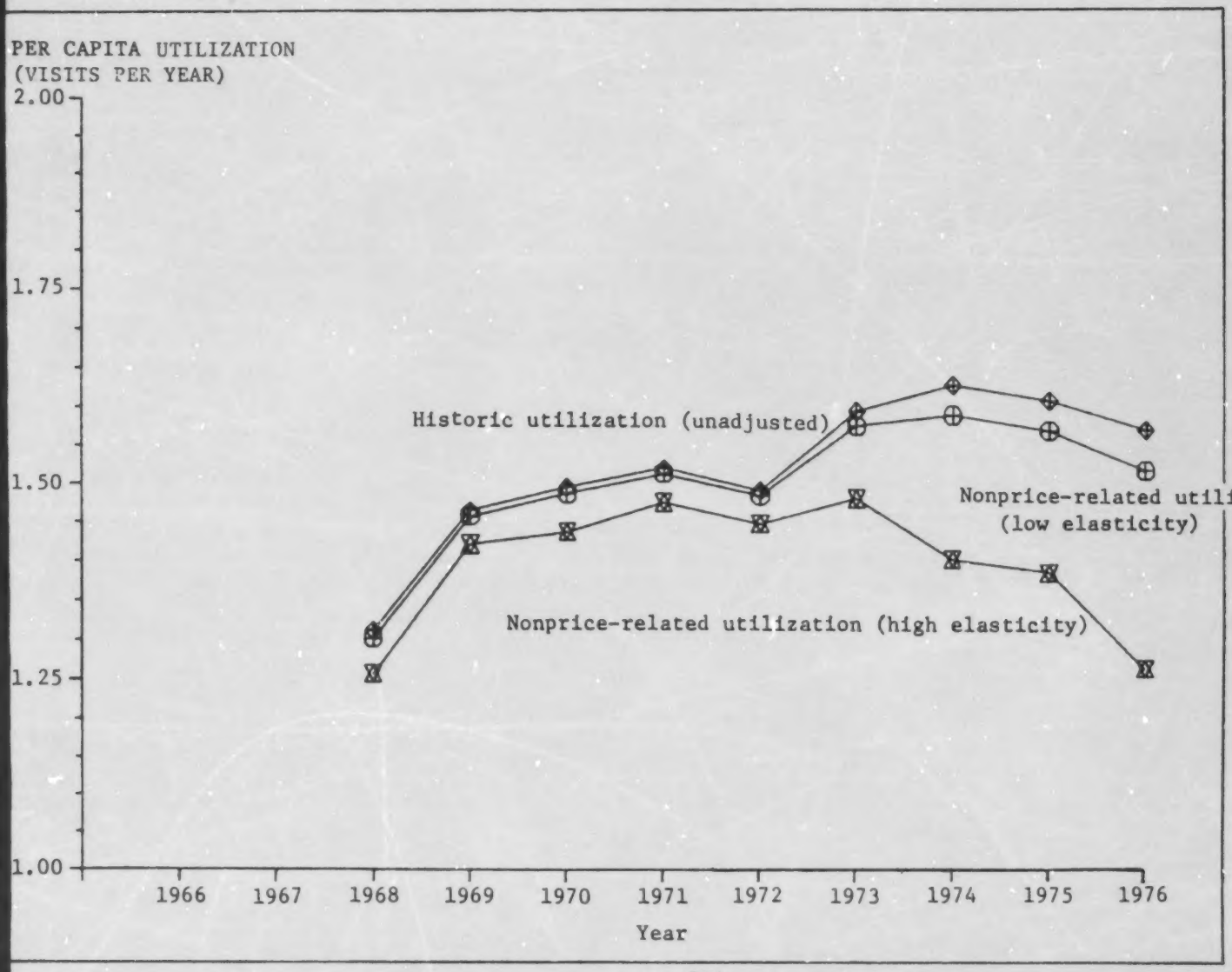
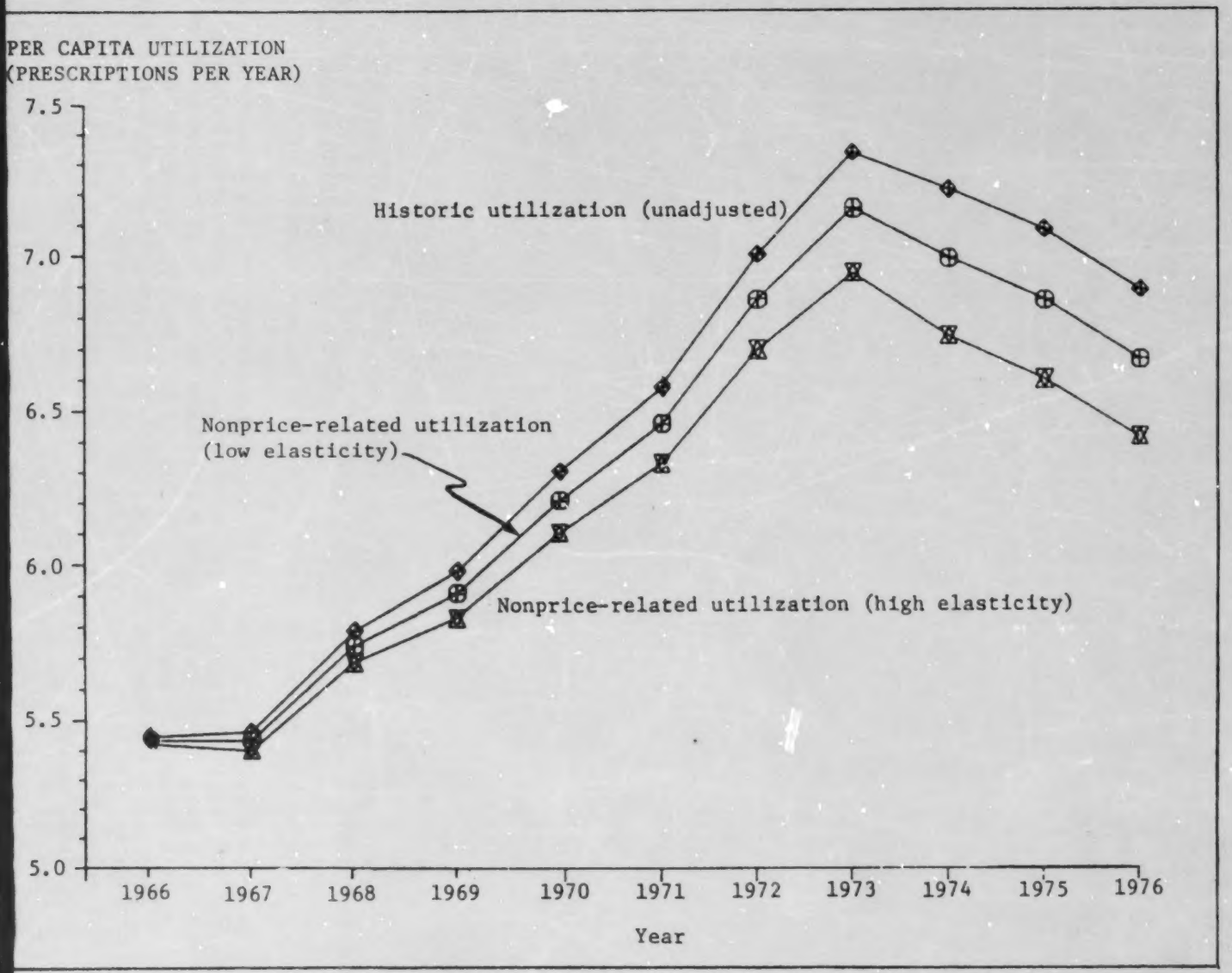


FIGURE 7: PER CAPITA UTILIZATION OF COMMUNITY PHARMACY SERVICES, 1966-1976



- First, the historic values of P_x ("the CPI for health care category x divided by the CPI for all items combined") and I_x ("the gross average coinsurance rate for health care category x") are extrapolated forward in time. In the case of P_x, the extrapolation is accomplished through ordinary least squares; in the case of I_x, the extrapolation may be accomplished either through ordinary least squares or through the so-called logit function, a sigmoid curve which varies between 0 and 1.

- The logit function is used to project the coinsurance rates for medical office and short-term hospital services, while the more conservative linear function has been used for pharmacy and dental forecasts.

- The extrapolated values of P_x and I_x are then multiplied to yield the estimated net price to the consumer (NPC) for the year to years in question. That value is then applied to the appropriate demand-price curve (linear, semi-log, or double log), using the prescribed value or values of elasticity.

In this manner, a single price-related adjustment factor is obtained for each year and for each form of care. These values are then applied, as multiplicative factors, to adjust the nonprice-related utilization trend for each year.

Over the past years, the net price of health care to the consumer has generally been declining because insurance benefit increases have more than offset increases in the price of medical services. There is no reason, however, why price changes might not, in the future, serve as a damper upon demand. In that case, the price-related adjustment would be downward.

Once these adjustments are made, the adjusted utilization values are then compared to those applicable in 1975. For a given form of care, the ratio of "projected utilization" to "utilization in 1975" constitutes the estimated growth (or decline) in the per capita utilization of that particular form of care. Those ratios, as derived by the Division of Health Professions Analysis using both high and low values of elasticity, are shown in table 11.

In summary, then, the utilization trend analysis involves four steps: (a) a factoring of historic per capita utilization data into both a price-related and a nonprice-related component, followed by (b) an extrapolation of each of those components separately into the future, and then (c) use of the extrapolated values to produce synthesized projections of future utilization. Finally, (d) those synthesized future utilization rates are compared to the rates applicable in 1975 and the resulting ratio is then used to express the projected growth or decline in personnel requirements for a particular form of care.

Table 11.

Estimated growth in per capita utilization four forms of health care

	Projected Per Capita Utilization in 1990 Relative to Baseline Utilization in 1975	
	Low Elasticity	High Elasticity
Medical Office Services	1.41	1.54
Short-Term Hospital Services	1.35	1.47
Dental Office Services	1.29	1.30
Community Pharmacy Services	1.13	1.17

Source: Runs conducted by the Division of Health Professions Analysis using the elasticity coefficients shown in table 10. The price-demand model used was double log; coinsurance was extrapolated using a logit fit for medical office and short-term hospital services and a linear fit for dental office and community pharmacy services.

After the growth factors for the utilization trend adjustment are computed, reflecting the effects of price, health insurance, and nonprice factors on consumer demand, an overall adjustment factor is computed for each category. For most categories, this factor is obtained by multiplying the factor in table 8 representing demographic effects times the factor in table 11 representing utilization trend adjustments. The resulting overall factors are given in table 12 for both values of the price elasticities. (Slight differences occur due to rounding.) However, sufficient data are not available to compute price and health insurance adjustments for care categories other than those presented in table 12. For long-term hospital care, laboratory services, other care, and veterinary services, the demographic effects factors in table 8 are used as overall factors. For nursing home care, optometric care, and podiatric care, the demographic effects factors are modified by special trend adjustments to reflect long-term trends in per capita utilization. This modification procedure is presented in appendix II.

Once the overall adjustment factors are computed, the model multiplies these factors times the 1975 base data on each occupation using the matrix in table 6. The resulting projections for 1990 are given in table 13.

To summarize this adjustment process, the medical office sector is used as an example in table 14. Table 14 traces step-by-step the generation of estimated requirements for physicians in medical office practice in 1990. Each specific category of medical office care is associated with a specific population-related growth factor, described earlier and shown in table 8. These population growth factors, labeled "A" in table 14, are each multiplied by a single factor (labeled "B" in the table) expressing growth in per capita utilization between 1975 and 1990. This utilization growth factor, also shown in table 11, is common to all categories of medical office care; its derivation was covered earlier in this chapter. The resulting products of "A" and "B," labeled "C", are overall utilization growth rates forecast to occur in specific categories of medical office services between 1975 and 1990. These overall growth rates are then multiplied by the numbers of physicians located in the various medical office settings in 1980, shown under column "D" in table 14, and presented in context of the entire physician base in table 5. The resulting products are the projected numbers of physicians, by medical office setting, estimated to be required in 1990 and shown under column "E" of table 14. The sum of these products is the total estimated requirement for office-based physicians in 1990. These requirements estimates undergo one further refinement in the model: they are adjusted to correspond to the 1975 baseline physician estimates produced by the DHPA physician supply model. The final, revised physician requirements estimates are shown in table 14 under column "F." Notice that this adjustment of the projected numbers of physicians in column "E" conceptually could have been made to the 1975 base; the adjustment was applied to the initial forecasts only for programming convenience.

The above sequence of operations has described the logic of the basic model and is applicable to any other forecasting period and health service category, and to any other set of assumptions about the parameters of the model. The blocked schematic diagram of the entire model in figure 1 will be helpful in visually relating the various components just described to other subunits of the model.

Table 12.

Projected overall utilization growth factors: 1975-1990

		Projected Growth (1975=100.0)	
		Low Price Elasticity	High Price Elasticity
Medical Office:	General Care	153.7	167.2
	Pediatric Care	142.7	155.2
	Ob-Gyn Care	170.1	185.0
	Psychiatric Care	176.0	191.5
	Vision Care	174.7	190.1
	Other Care	156.7	170.4
Short-Term Hospital:	Outpatient Care	129.4	140.3
	Surgical Care	150.1	162.3
	Medical Care	139.8	151.6
Additional Health Care Settings:	Dental Care	156.6	157.5
	Pharmacy Services	126.7	130.4

Source: DHPA projections using the BHPr personnel requirements model. These factors are the product of the demographic effects factors presented in table 8 and the price, health insurance, and nonprice effects factors given in table 11.

Table 13.

Projected requirements for physicians in medical offices and short-term hospitals, and for dentists and pharmacists: 1990

Profession	Requirements	1975-90 Percent Increase
Physicians		
Medical Office	337,800	65
General Care	95,400	61
Pediatric Care	34,700	49
Ob/Gyn Care	30,600	78
Psychiatric Care	29,900	84
Vision Care	16,700	83
Other Care	130,400	64
Short-term Hospital	177,800	51
Dentists	176,200	57
Pharmacists	156,300	28

1/ Estimates are the average of projections from the "low" and "high" alternate price elasticity series.

Table 14.

Illustrative computation of requirements for physicians (MD and DO) in medical offices: 1975-90[1/]

Setting	Specific growth factors (1975-90) A Projected population growth factor[2/]	Specific growth factors (1975-90) B Projected per capita utilization growth factor[3/]	C Overall growth factor (1975-90)[4/]	D Physicians in 1975[5/]	Requirements in 1990 E Basic[6/]	Requirements in 1990 F Revised[7/]
General	1.089	1.5353	1.672	57,565	96,249	99,337
Pediatric	1.011		1.552	21,500	33,368	36,096
Ob/Gyn	1.205		1.850	16,302	30,159	31,821
Psychiatric	1.247		1.915	15,115	28,945	31,122
Vision	1.238		1.901	8,844	16,812	17,747
Other	1.110		1.704	76,870	130,986	135,839
				196,196	336,520	352,002

1/ The computational sequence is notated as: AxB=C, CxD=E. "F" is a further refinement of "E." Computations are shown for the "high" price elasticity series only. Computations for "low" series are identical except for (B) per capita growth factors.

2/ From table 8.

3/ From table 11.

4/ These factors are also presented in table 12, and are the product of (A) demographic effects factors and (B) price, health insurance, and nonprice effects factors.

5/ From table 5.

6/ Estimates are shown in Appendix II, table T53C, under "Basic" series.

7/ Adjustment factors shown in Appendix II, table T51, are applied to adjust the 1975 MD physician base to correspond to the 1975 baseline physician estimates produced by the DHPA physician supply model. Corrected estimates are shown in Appendix II, table T53C under "1990 Revised."

The Contingency Configuration

The contingency version of the model goes further, examining changes in productivity as well as in utilization. Unlike the baseline version in which certain trends are examined and extrapolated, the contingency configuration explores phenomena for which trend data may not be available--or suitable. Among the issues which the contingency version of the model has been used to explore are:

- Alternative forms of National Health Insurance.
- Various rates of growth of the HMO movement.
- Increased use of physician extenders (i.e., "task delegation").

These and other issues may be explored using, in large measure, features of the model previously discussed.

National Health Insurance

The impact of national health insurance (NHI) is treated in the model through the use of the price and health insurance adjustment features. NHI, when and if adopted, is assumed to result in lower coinsurance rates for particular (but not necessarily all) forms of care. These reduced rates are specified (by the user of the model) as input for the year or years in question; they are then compared to the "average" coinsurance rates which would have been obtained in those years in the absence of NHI. An example of these comparative coinsurance rates is shown below:

	Average Coinsurance Rates			
	In the Absence of NHI[1]			Assuming NHI Is In Effect[2]
	1980	1985	1990	
Medical office visits	.35	.29	.24	.20
Short-term hospital stays	.09	.08	.08	.10
Dental visits	.71	.62	.53	.40
Community pharmacy services	.80	.75	.70	.40

1/ Division of Health Professions Analysis projections

2/ Hypothetical values chosen for study purposes

The non-NHI coinsurance rates for 1980 and succeeding years are taken from the baseline projections; as with the NHI rates, they are specified as part of the input process and may be varied. Where the non-NHI rate is less than the postulated NHI rate (as in the case, shown above, of short-term hospital stays in 1990), the user of the model may specify, if desired, that the non-NHI rate take precedence.

The model operates in the following stepwise fashion:

Step 1. For each form of care and for each year, the model calculates the ratio of the NHI to the non-NHI coinsurance rate. That ratio should in general be substantially less than 1.0.

Step 2. The model then applies each of the calculated ratios to the postulated demand elasticity curve (for that form of care) to determine the demand shift projected to take place as a result of the reduction in price due to NHI.

Step 3. Finally, the projected demand shift for each separate form of care is used to modify the utilization growth factors previously calculated in the model. Separate adjustments are made for each separate year for which NHI projections are desired.

Elaborating upon the last step, if the utilization ratio R(t) calculated to represent the effect of demographic factors is 1.12, while the utilization growth factors calculated in the price adjustment and contingency configurations are 1.07 and 1.18 respectively, it follows that the total utilization growth projected for the health care category in question is

$$1.12 \times 1.07 \times 1.18 = 1.414$$

or a 41.4 percent increase over the base year (1975). That, growth, as noted earlier, results in a corresponding growth in the requirements for each separate personnel type engaged in that particular form of care.

The model has served as the basis for assessing the implications of various national health insurance proposals and most notably was used to analyze the probable effects of the Nixon Administration's Comprehensive Health Insurance Plan. The results of this study have been published in "The Impact of Comprehensive National Health Insurance on Demand for Health Manpower," DHEW Publication No. (HRA) 78-102. The report presents estimates of increases in demand induced by CHIP in short-term hospitals, medical and dental offices and pharmacy services and expresses the demand shifts in terms of requirements for various health care personnel located in these settings.

The impact of a specific NHI program depends on the coinsurance rates specified in the plan and when the plan is enacted. In the hypothetical example given above, a much larger impact would occur if the plan were adopted in 1980 than in 1990. This is due to the projected decline in coinsurance

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12/ The closer the coinsurance ratio is to 1.0, the smaller the demand shift. The smaller the ratio, the larger the demand shift.

rates which is expected to occur over the period 1980-1990 as private health insurance and existing public programs continue to grow.

Further Growth of Health Maintenance Organizations

A Health Maintenance Organization is a legal entity which provides a prescribed range of services in return for a prepaid, fixed and uniform payment. Typically, the following services are provided:

- physician services, including consultation and referral;
- outpatient services;
- inpatient hospital services;
- emergency services;
- short-term outpatient evaluative and crisis intervention mental health services;
- diagnostic laboratory and diagnostic and therapeutic radiological services;
- home health services and preventive health services including voluntary family planning services, eye refractions and hearing examinations for children, immunizations and well-child care from birth;
- medical treatment and referral services for abuse of or addiction to alcohol and drugs.

Some HMO's may offer the services of long-term care and intermediate care facilities; vision, mental health and dental services; long-term rehabilitative services and prescription drugs.

The list of services which an HMO offers clarifies the kinds of health personnel an HMO may employ and affects the kinds of health personnel it will require in the future. Aside from the obvious need for physicians and such specialties as psychiatrists, pediatricians, obstetrician-gynecologists and radiologists, an HMO may also need (in addition to various levels of nursing care) such allied health personnel as audiologists, social workers, dentists, pharmacists, podiatrists, physical therapists, and optometrists. Thus, an HMO has its own set of personnel requirements, apart from those required by the general population who are not members of HMOs. As of the Spring of 1979, there were about 200 HMO-like organizations in the United States with a total membership of 6-7 million people--about 3 percent of the U.S. population--and about 85 of these organizations were federally certified as HMOs.

In the BHPr general requirements model the total population who belong to HMOs is treated as a distinct subset of the total U.S. population. The HMO members are assigned their own set of utilization rates, generally lower than those of the general population, and their own personnel matrix for 1975. Based on an

earlier study by GEOMET, Inc. it is assumed that about 6 percent of the U.S. population as a minimum will belong to HMOs in 1990. There is no price adjustment in the HMO model; the reason for this relates to the principles upon which HMOs operate. Unlike private fee-for-service care, the demand and utilization of HMO services is not necessarily affected by price. Although an HMO's premium level will influence the number of people who can afford to join an HMO, especially if they must pay the premiums out of their own pockets, HMO members can use an HMO's services as many times as they wish without paying additional fees. In fee-for-service medicine, patients pay for at least the coinsurance portion of the physician's office visit fee each time they seek a physician's services. The lower the fee, the more an individual may seek care; the higher the fee, the more likely it is that at least certain forms of care will be deferred. HMOs have eliminated this economic condition. Also, utilization rates are generally lower in HMOs than fee-for-service medicine. HMOs emphasize preventive care, hoping to find an illness in its incipient stages thereby avoiding expensive hospitalization, while private health insurance has until recently tended to encourage inpatient care as a means of assuring payment.

Given these inputs, the general requirements model performs two parallel sets of calculations, one for the general (non-HMO) population and one for those who belong to HMOs. The same 40 population segments (both sexes, five income categories, and four age brackets) are used to characterize both groups; only the numbers differ.

Three sets of inputs are needed to define the HMO scenario: (a) the number of persons within each population segment, by year; (b) the 1975 utilization rates applicable to each segment, by care category; and (c) the 1975 personnel matrix applicable to HMOs, by care category and personnel type.[13/]

Following the two sets (i.e., HMO and non-HMO) of calculations each year, the general population and HMO figures are summed to produce projected personnel totals for the nation as a whole. In addition to the combined nationwide totals, separate personnel projections are produced for the HMO population alone.

Use of Physician Extenders

This feature is handled through a special input table which permits the projected personnel requirements, in any given year, to be adjusted upward or downward in response to certain assumptions. The assumptions in question are specified by the user of the model and concern: (1) the extent to which physician tasks are delegated, in future years, to non-physician personnel types such as MEDEX personnel and nurse practitioners, and (2) the extent to which such task delegation enhances productivity.

13/ The DHPA estimates were based predominantly on data reported in Geomet, Inc., "HMO's": Their Potential Impact of Health Manpower Requirement," May 1973. Reported utilization of medical care was adjusted upwards by 2 percent to reflect care received out of plan; utilization of hospital care was limited to a selected (reliable) subset of the GEOMET sample; HMO enrollment profiles were adjusted to match DHHS estimates of the total HMO enrollment population in 1975 (6.041 million).

The calculations result in personnel adjustment factors which are then specified as input to the model. The input specifications involve identifying the number (or the percentage) of physicians who will not be needed with respect to a given care category in a given year as a result of the increased use of physician extenders. Both the decreased number of physicians and the increased number of physician extenders must be specified. The latter increase should in theory be that quantity (or percentage) of additional physician extenders needed to assure no loss in productivity.

Other adjustments to productivity, similar in kind to those involving physician extenders, may be made using the adjustment feature just described. Personnel adjustments, in other words, may by introduced in response to a variety of contingencies not necessarily related to the use of physician extenders.

CHAPTER III

SENSITIVITY TESTING

The BHPr general requirements model is dependent upon a host of assumptions. The major assumptions, categorized according to the generic topic under which they fall, are:

Assumptions Relating to POPULATION

- The United States resident population will increase at an annual rate of 0.7 percent, based on U.S. Bureau of the Census projections.
- The real income of the population (measured in 1970 dollars) will increase.
- Although there will be changes in the marginal distribution of family income and in the marginal distribution of individuals by age and sex, their joint distribution will remain as close as possible to that which existed in 1970 without violating marginal constraints.

Assumptions Relating to PRICE

- The demand for health care will continue to vary, with changes in the net price to the consumer--defined as the product of provider price[1/] and coinsurance rate (both expressed as gross nationwide averages).
- Provider prices will continue to follow recent trends.
- Coinsurance rates will continue to decline as indicated in recent trends.
- Consumer demand for health care and the net price are linked by a predetermined functional relationship, invariant in time.

Assumptions Relating to UTILIZATION

- The nonprice-related component of utilization will continue to follow recent trends.
- Except for that resulting from the use of expanded function aides, there will be no future changes in the productivity of individual practitioners.

1/ Normalized with respect to the CPI for all items combined.

- No further substitution will take place among personnel or care categories beyond that accounted for in the baseline personnel configuration.

To investigate the sensitivity of the model to these assumptions and to their associated parameters where relevant, the series of computer runs described below was conducted.

The Impact of Alternative Population Projections

As noted in earlier sections, the population projections employed in the model create changes both in the size of the population and in its age/sex/income composition. These changes in turn affect the projected utilization of certain forms of health care, which in turn impacts upon the required personnel supply.

Changes in size alone translate directly into changes in personnel requirements. A 10 percent increase in population, for example, yields a 10 percent increase in personnel requirements for all personnel types, and so on.

The changes which require examination are those which create differential impacts--i.e., which cause a shift in the age/sex/income distribution. To investigate such changes several simulations were performed. The baseline projection consisted of the standard requirements model run in which all three variables--age, sex, and income--were advanced in time as prescribed in the fundamental model design. In subsequent runs each of these factors was allowed to vary singly and in combination.

Each of the runs took the form of examining the impact of the modified population projections upon the projected utilization of care. The categories investigated were as follows:

Medical office care:	General
	Pediatric
	Ob-gyn
	Vision
	Psychiatric
	Other
Short-term hospital:	Outpatient
	Surgical
	Medical
Long-term hospital:	Psychiatric
Other care settings:	Nursing homes
	Dental care
	Optometric care
	Podiatric care
	Community pharmacy services

Changes in the sex composition of the population, over a 15- to 25-year period, are simply too minor to reflect themselves in marked utilization changes; as a consequence, it makes little difference whether populations are distinguished according to the attribute sex.

As shown in table 15, the following forms of care are positively affected by projected changes in age but negatively affected by income changes:

Office-based general care.
Office-based "other" care.
All three forms of short-term hospital care.
Nursing home care.
Community pharmacy services.

The following forms of care are negatively affected by projected changes in age but positively affected by income changes:

Office-based pediatric care.
Dental care.

Some of these effects are easier to "explain" than others. Permitting age to vary, for example, is known to result in a generally older population, thereby accounting for the observed decline in pediatric care and increase in vision care, nursing home care, etc. Permitting income to vary results in an upwardly mobile population which favors those forms of care (psychiatric, dental, etc.) more likely to be deferrable.

The impact of population changes depends upon the utilization rates explicitly assigned to each of the forty population segments which together define the U.S. population. A projected increase in utilization simply denotes that there has been a shift in population toward cells with higher utilization rates; a decline in utilization denotes the converse.

Runs Relating to Price and Utilization

The runs conducted in this series were directed predominantly toward the following issues:

- The underlying nature of the demand-price relationship (linear, semi-log, double log).
- The coefficients used to characterize the price elasticity of demand.
- The form of fit used to extrapolate coinsurance (logit vs. linear).

Functional nature of the demand-price relationship. - To explore this issue, the dependent variable "per capita utilization" was regressed on the independent variable "net price to the consumer," for each of the following forms of care:

TABLE 15.

The effect of demographic factors on per capita care utilization, 1975-1990

		Projected Growth Factor, 1975-1990 (1975=100)		
		Age Varies	Income Varies	Both Vary
Medical office care:	General	102.5	95.5	98.5
	Pediatric	84.1	108.8	91.6
	Ob-gyn	108.2	103.2	108.7
	Vision	103.4	102.4	111.9
	Psychiatric	110.0	107.4	112.8
	Other	103.6	98.0	100.5
Short-term hospital:	Outpatient	101.3	85.5	86.5
	Surgical	104.4	95.2	100.3
	Medical	104.1	86.7	93.5
Long-term hospital:	Psychiatric	106.7	103.1	107.6
Other care settings:	Nursing homes	114.6	75.4	115.0
	Dental care	99.1	111.7	110.0
	Optometric care	100.9	104.8	105.3
	Podiatric care	104.7	112.9	115.3
	Community pharmacy services	104.6	93.9	101.0

SOURCE: Computer runs conducted by DHPA.

	Years for which price and utilization data were available[2/]
Medical office services	1966 through 1976
Short-term hospital services	1966 through 1976
Dental office services	1968 through 1976
Community pharmacy services	1966 through 1976

For each form of care, three forms of regression were applied: linear, semi-log, and double log. It was found that:

Price-demand elasticity coefficients. - If there were no other factors involved, the regression coefficients derived in the preceding set of runs would serve, in the case of the double log model, to indicate the price elasticity of demand. The derived coefficients, as compared to those assumed in the model, are as follows:

	Derived Elasticity	Elasticity Coefficients Assumed in the Model	
		Low	High
Medical office services	-0.61	-0.14	-0.30
Short-term hospital services	+0.19	-0.08	-0.20
Dental office services	-0.56	-0.16	-1.00
Commuity phramcy services	-0.64	-0.07	-0.15

On three of the four health service categories, the derived elasticity coefficient is seen to lie well outside the range postulated within the model--a likely reflection of the many factors other than price which serve to influence demand.

The relative lack of sensitivity of the model to the specific elasticity coefficients is reflected in the following table:

2/ Utilization data were obtained from the following sources: physician and dental office services from NCHS Health Interview Survey reports; short-term hospital services from admissions to non-Federal short-term general and other special hospitals as reported in the Hospital Guide issues, Hospitals, American Hospital Association; and community pharmacy services from data on new and refill prescription acquisitions obtained through personal correspondence by DHPA. Overall utilization was then converted to per capita utilization based on Bureau of the Census reports on the U.S. Civilian Resident Population for each of the years in question.

	Projected Growth in Per Capita Utilization, 1975-1990 (1975=100)	
	Low Elasticity	High Elasticity
Medical office services[3/]	136.5	145.1
Short-term hospital services	129.4	138.1
Dental office services	128.8	128.0
Community pharmacy services	150.5	158.2

Linear vs. logit coinsurance fit. - The differences in results between using a linear as opposed to a logit fit for coinsurance are shown below:

	Projected Growth in Per Capita Utilization, 1975-1990 (1975=100)			
Coinsurance:	Linear Fit		Logit Fit	
Elasticity:	Low	High	Low	High
Medical office services	142.5	159.0	136.5	145.1
Short-term hospital services	146.9	189.6	129.4	138.1
Dental office services	128.8	128.0	149.2	321.0[4/]
Community pharmacy services	150.5	158.2	151.5	160.5

For physician office and short-term hospital services, the logit fit is seen to produce a substantially narrower, somewhat lower range of results; for dental office services, the situation is sharply reversed; while for community pharmacy services the linear fit is slightly less variable. These variations can be traced to the original coinsurance data.

3/ A logit fit was applied to coinsurance in the case of physician and short-term hospital services; dental and pharmacy services received a linear fit.

4/ This discrepant result demonstrates the hazards of applying a logit fit to points which lie within a relatively narrow portion of the range between 0 and 1.

To explore the sensitivity of the non-price trend to changes in the length of the utilization trend data, start dates of 1966, 1968, and 1971 were applied to all four forms of care. In each case, an end date of 1976 was used. As might be expected with such few numbers of observation, the results show a clear dependence upon start date for all but short-term hospital services. In the case of physician office services, a start date of either 1966 or 1968 is seen to yield a distinctly upward trend, whereas a start date of 1971 shows a downward slope. Similar differences as a function of start date are noted for dental and pharmacy services, reflecting the fact that the per capita utilization of those forms of care has actually been declining over the past 6 years. As a consequence, trend extrapolations based on a start date of 1966 or 1968 yield substantially higher projections than those based on a start date of 1971 (from which the Medicare/Medicaid startup years have been excluded). The magnitude of the disparity is evident from the following:

		Projected growth in nonprice-related per capita utilization, 1975-1990 (1975=100)		
	Start Date:	1966	1968	1971
	Elasticity			
Medical office services:	High	116.3	123.0	89.9
	Low	123.1	127.3	95.4
Short-term hospital services:	High	123.8	131.4	123.4
	Low	123.9	129.9	129.9
Dental office services:	High	NA	97.5	56.3
	Low	NA	123.3	106.9
Community pharmacy services:	High	135.6	129.4	100.1
	Low	140.1	134.1	105.6

APPENDIX I

DERIVATION OF THE HEALTH PERSONNEL MATRIX

The model assumes a reference matrix which allocates personnel types to care categories in a given base year (1975). This matrix is presented in table 1. The personnel staffing matrix was originally derived for 1970 and subsequently updated to 1975 using similar methods. The following discussion pertains to the 1970 matrix. The reader is reminded that throughout this discussion, the personnel types described follow the categorization shown above in table 5 of Chapter II while the care categories are those shown in table 3.

PHYSICIANS--MEDICAL DOCTORS

The estimated number of medical doctors active in 1970, by specialty and principal setting (office, hospital, or other), is shown in table 1. These numbers were based on the American Medical Association's Distribution of Physicians in the United States for 1970, with the various specialties regrouped to provide a more compact typology. The allocation of physicians to care categories was accomplished in the manner described below.

General MDs

This category was defined to include those in general practice, internal medicine, or those whose specialty was unspecified. As shown, there were 112,306 such physicians active in 1970, of whom 76,724 were office-based, 28,379 hospital-based, and 7,203 based in other settings.

Method for Allocating Office-Based Care

First, the percentage of office visits to general practitioners and internists which involved the 50 most common diagnoses was identified using the National Drug and Therapeutic Index (NDTI).[1/] Slightly over 63 percent of visits to general practitioners and nearly 60 percent of visits to internists were found to be accounted for by those diagnoses. The percentage of these visits identified as obstetrical and gynecological was then subtracted out and assigned to Ob-Gyn care while the percentage involving nervous disorders and

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1/ Unpublished data for 1972 from the National Drug and Therapeutic Index.

Table 1.

Health personnel by care setting and activity in 1975

1. MEDICAL OFFICE CARE

		Persons Involved in this Form of care	Percent of all Persons of This Occupation/Specialty
A. General Care			
Physicians (MD):	General	36,476	31.3
	Pediatric	568	2.6
	Ob/Gyn	2,634	12.1
	Surgery	3,516	4.6
	Secondary specialist	3,299	6.8
Physicians (DO)		11,072	76.2
Registered Nurses		19,964	2.1
Physician Extenders		1,392	17.1
Allied Health Personnel:	Administration	52,034	7.6
	Clinical lab	8,601	4.6
	Radiologic	3,129	3.0
	Nursing care	8,206	0.6
B. Pediatric Care			
Physicians (MD):	General	9,392	8.1
	Pediatric	12,061	55.5
Physicians (DO)		47	0.3
Registered Nurses		8,905	0.9
Physician Extenders		375	4.8
Allied Health Personnel:	Administration	17,782	2.6
	Clinical lab	1,648	0.9
	Radiologic	538	0.5
	Nursing care	3,081	0.2

		Persons Involved in this Form of care	Percent of all Persons of This Occupation/Specialty
C. Ob/Gyn Care			
Physicians (MD):	General	2,895	2.5
	Ob/Gyn	12,964	59.7
	Surgery	396	0.5
Physicians (DO)		47	0.3
Registered Nurses		8,611	0.9
Physician Extenders		142	1.8
Allied Health Personnel:	Administration	16,176	2.4
	Clinical lab	1,245	0.7
	Radiologic	413	0.4
	Nursing care	2,859	0.2
D. Vision Care			
Physicians (MD):	Ophthalmology	8,820	79.3
Physicians (DO)		24	0.2
Allied Health Personnel:	Administration	11,507	1.7
	Vision Care	35,000	100.0
E. Psychiatric Care			
Physicians (MD):	General	1,081	0.9
	Ob/Gyn	79	0.4
	Psychiatry	13,857	52.3
	Surgery	63	0.1
Physicians (DO)		35	0.2
Registered Nurses		619	0.1
Allied Health Personnel:	Administration	4,718	0.7
	Clinical lab	17	0.01
	Nursing care	204	0.01

		Persons Involved in this Form of care	Percent of all Persons of This Occupation/Specialty
F. Other Care (Office-Based)			
Physicians (MD):	General	26,995	23.2
	Pediatric	271	1.3
	Surgery	24,003	31.6
	Secondary specialist	25,137	52.0
Physicians (DO)		464	4.2
Registered Nurses		27,633	2.9
Physician Extenders		413	5.3
Allied Health Personnel:	Administration	83,780	12.3
	Clinical lab	14,560	8.0
	Radiologic	24,471	23.3
	General medical	642	0.7
	Nursing care	7,790	0.5

2. Hospital Care

		Persons Involved in this Form of care	Percent of all Persons of This Occupation/Specialty
A. Short-term Hospital (Outpatient)			
Physicians (MD):	General	5,660	4.7
	Pediatric	638	2.9
	Psychiatry	1,746	6.6
	Secondary specialist	437	0.9
Physicians (DO)		312	2.2
Podiatrists		196	2.8
Pharmacists		5,697	4.7
Registered Nurses		34,629	3.6
Physician Extenders		1,421	18.1
Allied Health Personnel:	Administration	39,668	5.8
	Medical librarian	879	8.2
	Medical records	9,105	14.2
	Clinical lab	23,088	12.7
	Radiologic	10,752	10.2
	Therapy	10,498	6.3
	General medical	6,716	7.8
	Nursing care	42,185	2.9
	Pharmacy	2,667	2.7
	Dental care	390	0.2

		Persons Involved in this Form of care	Percent of all Persons of This Occupation/Specialty
B. Short-term Hospital (Surgical)			
Physicians (MD):	General	1,351	1.2
	Pediatric	49	0.2
	Ob/Gyn	5,156	23.7
	Ophthalmology	1,991	17.9
	Surgery	45,289	59.6
	Secondary specialist	4,374	9.1
	Noncare specialist	5,491	29.8
Physicians (DO)		254	1.7
Dentists		3,639	3.2
Podiatrists		239	3.4
Pharmacists		2,848	2.3
Registered Nurses		271,843	28.3
Physician Extenders		636	8.1
Allied Health Personnel:	Administration	106,021	15.5
	Medical librarian	1,757	16.4
	Medical records	18,210	28.5
	Clinical lab	46,176	25.4
	Dietary	20,027	26.7
	Radiologic	21,504	20.5
	Therapy	20,995	12.7
	General medical	7,337	8.5
	Nursing care	301,382	20.5
	Pharmacy	5,500	5.5
	Dental care	390	0.2

		Persons Involved in this Form of care	Percent of all Persons of This Occupation/Specialty
C. Short-term Hospital (Medical)			
Physicians (MD):	General	21,292	18.3
	Pediatric	6,179	28.4
	Psychiatry	1,392	5.3
	Secondary specialist	6,124	12.7
	Noncare specialist	693	3.8
Physicians (DO)		1,210	8.3
Pharmacists		2,848	2.3
Registered Nurses		270,689	28.2
Physician Extenders		637	8.1
Allied Health Personnel:	Administration	106,012	15.5
	Medical librarian	1,757	16.4
	Medical record	18,210	28.5
	Clinical lab	46,176	25.4
	Dietary	20,027	26.7
	Radiologic	21,504	20.5
	Therapy	20,995	12.7
	General medical	24,021	27.8
	Nursing care	301,382	20.5
	Pharmacy	5,500	5.5

		Persons Involved in this Form of care	Percent of all Persons of This Occupation/Specialty
D. Long-term Hospital (Psychiatric)			
Physicians (MD):	General	3,103	2.7
	Psychiatry	6,231	23.5
Dentists		2,589	2.3
Pharmacists		1,644	1.3
Registered Nurses		33,912	3.5
Physician Extenders		147	1.9
Allied Health Personnel:	Administration	82,242	12.1
	Medical librarian	1,014	9.5
	Medical records	8,490	13.3
	Clinical lab	7,735	4.3
	Dietary	6,223	8.3
	Radiologic	3,360	3.2
	Therapy	27,216	16.5
	General medical	2,727	3.2
	Nursing care	183,467	12.5
	Pharmacy	1,500	1.5
	Dental care	4,232	2.4

		Persons Involved in this Form of care	Percent of all Persons of This Occupation/Specialty
E. Long-term Hospital (Other)			
Physicians (MD):	General	1,476	1.3
	Pediatric	131	0.6
	Secondary specialist	1,707	3.5
Physicians (DO)		166	1.1
Dentists		523	0.5
Pharmacists		333	0.3
Registered Nurses		15,595	1.6
Physician Extenders		71	0.9
Allied Health Personnel:	Administration	23,332	3.4
	Medical librarian	1,014	9.5
	Medical record	2,257	3.5
	Clinical lab	7,735	4.3
	Dietary	2,872	3.8
	Radiologic	3,360	3.2
	Therapy	10,627	6.4
	General medical	6,513	7.5
	Nursing care	72,129	4.9
	Pharmacy	1,500	1.5
	Dental care	3,011	1.7

3. OTHER CARE SETTINGS

		Persons Involved in this Form of care	Percent of all Persons of This Occupation/Specialty
A. Nursing Homes			
Physicians (MD): General		594	0.5
Podiatrists		458	6.4
Pharmacists		547	0.5
Registered Nurses		67,751	7.1
Allied Health Personnel:	Administration	49,508	7.3
	Medical records	3,623	5.7
	Dietary	14,362	19.2
	Therapy	26,568	16.1
	Nursing care	382,972	26.1
	Pharmacy	333	0.3
B. Dental Care			
Dentists		104,338	90.7
Allied Health Personnel:	Administration	31,321	4.6
	Dental care	167,778	95.4
C. Veterinarian Care			
Veterinarians		29,010	93.4
D. Optometric Care			
Optometrists		19,701	98.0
Allied Health Personnel:	Administration	8,700	1.3

		Persons Involved in this Form of care	Percent of all Persons of This Occupation/Specialty
E. Podiatric Care			
Podiatrists		6,370	87.4
Allied Health Personnel:	Administration	3,000	0.4
	General medical	3,000	3.5

		Persons Involved in this Form of care	Percent of all Persons of This Occupation/Specialty
F. Pharmacy Services			
Pharmacists		98,656	80.5%
Allied Health Personnel:	Pharmacy	83,333	83.0
G. Laboratory Services			
Physicians (MD):	Noncare specialist	4,309	23.4
Allied Health Personnel:	Clinical lab	25,019	13.7
	Radiologic	15,970	15.2
	General medical	8,299	9.6
H. Other Care, Not Elsewhere Specified			
Physicians (MD):	Noncare specialist	2,611	14.2
Registered Nurses		159,622	16.6
Physician Extenders		2,600	33.0
Allied Health Personnel:	Administration	46,306	6.8
	Medical records	4,106	6.3
	Dietary	9,894	13.2
	Therapy	48,600	29.3
	General medical	1,604	1.9
	Nursing care	163,342	11.1

4. Non Patient Care Activities

Physicians (MD):	General	6,115	5.3
	Pediatric	1,849	8.5
	Ob/Gyn	898	4.1
	Ophthalmology	318	2.9
	Psychiatry	3,276	12.4
	Surgery	2,750	3.6
	Secondary specialist	7,244	15.0
	Noncare specialist	5,299	28.8
Physicians (DO)		901	6.2
Dentists		3,910	3.4
Optometrists		400	2.0
Podiatrists		37	0.1
Pharmacists		9,927	8.1
Veterinarians		2,050	6.6
Registered Nurses		41,227	4.2
Physician Extenders		20	0.3
Allied Health Personnel:	Medical librarian	4,280	40.0
	Dietary	1,596	2.1
	General medical	25,668	29.7

Active physicians (MD) by specialty group and practice setting: 1970

Specialty Group	Total	Office Based	Hospital Based	Other
Total active MDs	310,845	192,439	86,096	32,310
General MDs[1/]	112,306	76,724	28,379	7,203
Pediatrics	17,941	10,520	5,518	1,903
Obstetrics-Gynecology	18,876	13,910	3,977	989
Ophthalmology	9,927	7,662	1,851	414
Psychiatry[2/]	23,236	11,383	8,580	3,273
Surgery[3/]	68,099	45,078	19,716	3,305
Secondary Specialists[4/]	42,243	20,990	12,435	8,818
Nonpatient Care Specialists[5/]	18,217	6,172	5,640	6,405

1/ Includes general practice, internal medicine, and specialty unspecified.

2/ Includes psychiatry and child psychiatry.

3/ Includes general surgery, neurological surgery, orthopedic surgery, otolaryngology, plastic surgery, colon and rectal surgery, thoracic surgery, urology, and anesthesiology.

4/ Includes allergy, cardiovascular diseases, dermatology, gastroenterology, pediatric allergy, pediatric cardiology, pulmonary diseases, radiology, diagnostic radiology, therapeutic radiology, neurology, physical medicine and rehabilitation, and "other specialties."

5/ Includes occupational medicine, general preventive medicine, public health, aerospace medicine, forensic pathology, and pathology.

Source: Based on data contained in Distribution of Physicians in the United States, 1970. Chicago, American Medical Association, 1971.

medical-surgical care were assigned to Psychiatric and Other care respectively. Those visits remaining were tentatively assigned to the General care category. Visits to general practitioners and internists involving diagnoses which were not among the 50 most common diagnoses were arbitrarily assigned to Other care.

The next step was to estimate the number of visits involving Pediatric care. This was done by making use of data from the 1973 National Ambulatory Medical Care Survey,[2/] in which it was reported that 16.6 percent of visits to general practitioners and 2.6 percent of visits to internists involved children under 15 years of age. These percentages were converted to the equivalent total number of visits; that number was then subtracted, half from General care and half from Other care, and assigned to the Pediatric care category.

The final step in this process was to assign to physicians of unspecified specialty--for whom suitable data were lacking--the same care profile as that developed for general practitioners and internists. These profiles (numbers of visits) were then converted to FTE numbers of physicians by adopting the simplifying assumption that all office visits are of equal length; that is to say, a care category which accounts for x percent of all visits was automatically assumed to account for x percent of all physicians.

Method for Allocating Hospital-Based Care

The 28,379 general MDs in hospital-based practice were assigned to short-term and long-term hospital care categories in the following manner:

Short-term Hospitals

- All interns were allocated to short-term hospitals based on the 1971 Guide Issue of Hospitals[3/] which reported that almost all internship programs were in short-term hospital settings. The Guide Issue also reported that 82 percent of all residency programs were in short-term hospital settings. Professional judgment, however, suggested that this figure might be somewhat low for residency programs in general and family practice, internal medicine and unspecified specialties. As a consequence, 90 percent of these residents were assigned to short-term hospitals. The remaining 10 percent were assigned to long-term hospitals.

2/ DeLozier, James E. National Ambulatory Medical Care Survey, 1973. Summary. DHEW Publication No. (HRA) 76-1772. Rockville, MD, National Center for Health Statistics, October 1975.

3/ Hospitals, Vol. 45, No. 15, Part 2. Guide Issue, August 1, 1971.

- Staff MDs were allocated to short-term hospitals based on a 1969 survey[4] which showed that 69 percent of staff physicians were in short-term hospitals. The remaining 31 percent of staff physicians were assigned to long-term hospitals.

- Twenty percent of MDs in short-term hospitals were arbitrarily assigned to Outpatient care. The remaining M.D.s were distributed based on data from a study by the National Center for Health Statistics[5] and the Study on Surgical Services in the United States (SOSSUS).[6] The NCHS study reported that 45 percent of patients discharged from short-term hospitals had undergone surgery. SOSSUS showed that 49 percent of surgery performed in short-term hospitals was by general practitioners and medical specialists. These two figures multiplied together produced the percent of general hospital staff (22 percent) allocated to Surgical care. The remaining 78 percent were assigned to the Medical care category.

Long-Term Hospitals

- Since few residents and interns in long-term hospitals are likely to be furnishing psychiatric care, they were assigned to the Other care category. Ninety percent of the staff MDs in long-term hospitals were allocated to Psychiatric care, since it was assumed that the bulk of their care activity was provided in psychiatric hospitals, and the rest to Other care.

Method for Allocating Other Activities

The 7,203 general MDs who were neither office- nor hospital-based were assigned to care categories based on the 1970 Census of Population.[7]

4/ Losee, Garrie J., and Altenderfer, Marion E. Health Manpower in Hospitals. Washington: U.S. Government Printing Office, 1970.

5/ Witkin, Michael J. Patients Discharged from Short-Stay Hospitals. Public Health Service Publication No. 1000, Series 13, No. 1. Washington: U.S. Government Printing Office, October 1966.

6/ Surgery in the United States, A Summary Report of the Study on Surgical Services in the United States. The American College of Surgeons and the American Surgical Association, 1975.

7/ U.S. Bureau of the Census, 1970. Occupation by Industry, 1970 Census by Population. Final Report, PC(2)-7C. Washington: U.S. Government Printing Office, 1972.

The Census showed that 586 physicians were working in convalescent institutions; that number of physicians was thus assigned to the Nursing Home care category. The remaining 6,617 general MDs were allocated to Noncare activities.

OTHER SPECIALTY GROUPS

Method for Allocating Office-Based Care

Pediatricians. - The allocation of office-based prediatricians was accomplished on the basis of age, making use of data from the 1973 National Ambulatory Medical Care Survey. According to the survey, 93.5 percent of the office visits to pediatricians involved patients under 15 years; that percentage of office-based pediatricians was therefore assigned to the Pediatric care category. The survey further reported that 4.4 percent of pediatric visits involved persons between 15 and 24, and 2.1 percent involved persons 25 and over. Those percentages of pediatricians were arbitrarily assigned to the General and Other care categories, respectively.

Ob-Gyn. - As in the case of general MDs, obstetrician-gynecologists were allocated to care categories using data from the National Drug and Therapeutic Index (and assuming, as before, all office visits to be of equal length). Seventy-four percent of office visits to obstetrician-gynecologists were reported by the NDTI to be for the 50 most common diagnoses. Visits for pregnancy (56.7 percent) and nervous disorders (0.5 percent) were subtracted from that total and assigned respectively to Obstetrical-Gynecological care and Psychiatric care. The remaining 16.8 percent were allocated to General care.

The percentage of office visits (26 percent) to obstetrician-gynecologists involving diagnosis other than the 50 most common were added to the Ob-Gyn care category.

Ophthalmologists. - All 7,662 office-based ophthalmologists were assigned to Vision care.

Psychiatrists. - All 11,383 office-based psychiatrists were assigned to Psychiatric care.

Surgeons. - The 45,078 surgeons reported to be office-based were allocated to medical office care categories by using NDTI data to identify visits for the 50 most common diagnoses. For each surgical subspecialty the small percent of visits identified as ob-gyn and psychiatric were assigned to those care categories, respectively. Visits not related to surgery were placed in the General care category.

Office-based visits for diagnoses other than the 50 most common were divided into two equal groups. Since there is no surgical care category in the medical office classification, one group was assigned to Other care; the second group was assigned to Surgical care in the short-term hospital classification. (Support for a roughly 50-50 allocation is derived from an

AMA report[8] which indicated that surgeons spend 47 percent of their time on hospital rounds and in the operating room, while SOSSUS[9] reports that 58 percent of a surgeon's time is spent in hospital activities. Those percentages were assumed to apply to surgeons who are nominally office-based as well as those who are hospital-based.)

Secondary Specialists. - Again, the first step in allocating office-based secondary specialists was to identify for each specialty the percent of visits for the 50 most common diagnoses. For the specialties of cardiology, gastroenterology, and dermatology the percent of visits for diagnoses not related to the specialty was subtracted out, and the corresponding percentage of physicians was placed in the General care category. The remaining 18,555 office-based secondary specialists were assigned to the Other care category.

Nonpatient Care Specialists. - Pathologists and forensic pathologists included in the 6,172 MDs listed as office-based noncare specialists were assigned to the Laboratory Services category under the Noncare Settings classification. The remaining office-based MDs were placed in the same classification under the category of Noncare activites.

Method for Allocating Hospital-Based Care

Pediatricians. - All pediatric interns and residents were assigned to short-term hospitals. Since most long-term hospitals are psychiatric (in which care to children would most likely be provided by child psychiatrists), 95 percent of staff pediatricians were allocated to short-term hospitals and only 5 percent to long-term. Within each of these settings, the following further allocation took place:

1. Short-Term Hospitals

   Ninety percent of the staff pediatricians in short-term hospitals were assumed to be providing Medical care. The rest were divided between Outpatient care (8 percent) and Surgical care (2 percent).

2. Long-Term Hospitals

   All pediatricians in long-term hospitals were assumed to be working in Other (i.e., non-psychiatric) care.

8/ Profile of Medical Practice, 1974. Chicago, American Medical Association, 1974.

9/ Surgery in the United States. A Summary Report of the Study of Surgical Services in the United State. The American College of Surgeons and the American Surgical Association, 1975.

Ob-Gyn. - The National Center for Health Statistics considers childbirth to be a surgical procedure. Consequently, all 3,977 hospital-based obstetrician-gynecologists were assigned to Surgical care in the short-term hospital category.

Psychiatrists. - The National Institute of Mental Health's (NIMH) publication Staffing of Mental Hospital Facilities[10/] was used to allocate psychiatrists to short- and long-term hospitals. Psychiatrists and residents employed in general hospitals were placed in the short-term hospital classification; those employed in mental and veterans hospitals were assigned to the long-term classification.

The NIMH report provided information used to assign slightly over half of the psychiatrists in short-term hospitals (1,599) to the Outpatient care category. The remaining staff psychiatrists (1,275) were assigned to Medical care. All psychiatrists in long-term hospitals were assigned to Psychiatric care.

Surgeons. - All 19,716 hospital-based surgeons were assigned to Surgical care in short-term hospitals and added to the number previously assigned to this category from the office-based classification.

Secondary Specialists. - Hospital-based specialists in pulmonary diseases and physical medicine and rehabiliation were assigned to the Other category of long-term hospitals. The remaining secondary specialists were placed in the short-term hospital classification and distributed 56 percent to Medical care, 40 percent to Surgical care, and 4 percent to Outpatient care.

Noncare Specialists. - Pathologists and forensic pathologists shown to be hospital-based by the AMA were allocated to Surgical care in short-term hospitals. The remaining hospital-based nonpatient care specialists were placed in the short-term hospital Medical care category.

Method for Allocating Other Activities

Apart from general MDs, all physicians listed as neither office- nor hospital-based were arbitrarily assigned to Noncare activities.

PHYSICIANS--OSTEOPATHS

The American Osteopathic Association (AOA) reported 12,000 active osteopaths (DOs) in 1970. This number, plus a 1974 master file tape obtained from the AOA, was the basis for the care allocations shown below.

10/ National Institute of Mental Health. Staffing of Mental Health Facilities, United States, 1972. DHEW Publication No. (ADM) 74-28. Washington: U.S. Government Printing Office, 1971.

Method for Allocating Office-Based Care

With the exception of surgeons, office-based DOs were assigned to care categories based on specialty distribution information obtained from the 1974 tape. As in the case of MDs, half of the DOs who specialized in surgery and were reported to be office-based were assigned to the Surgical care category in the short-term hospital classification; the rest were assigned to Other care, office-based.

Method for Allocating Hospital-Based Care

The allocation of osteopaths to short- and long-term hospitals, and to care categories within each setting, was identical to that for general MDs with the following exception: since few DOs specialize in psychiatry, all osteopaths assigned to long-term hospitals were placed in the category of Other care.

Method for Allocating Other Care

The 744 DOs who were neither hospital- nor office-based were assigned to Noncare activities.

DENTISTS

The Division of Dentistry of the Bureau of Health Professions estimated that there were 102,200 active dentists in 1970 of whom 98,725 were involved in patient care.

Method for Allocating Patient Care

Based on data from the 1969 Survey of Health Manpower in Hospitals,[11/] 3,234 dentists were assigned to short-term hospitals and 2,766 to long-term hospitals. The former group was placed in the Surgical care category, while the latter group was assigned to the Psychiatric and Other care categories based on bed distribution data reported in Hospitals.[12/] The remaining dentists involved in patient care were assigned to the Dental care category.

Method for Allocating Nonpatient Care

The 3,475 dentists not reported to be in patient care were allocated to Noncare activities.

11/ Losee and Altenderfer, op. cit.

12/ Hospitals, Vol. 45, No. 15, Part 2. Guide Issue. August 1, 1971.

OPTOMETRISTS

A 1968 survey of optometrists conducted by the National Center for Health Statistics[13] and a 1972-73 inventory conducted by the American Optometric Association and supported by the Bureau of Health Professions, were used to estimate the number of optometrists in 1970. Of the estimated 19,100, 18,909 (99 percent) were estimated to be in patient care and were assigned to the Vision care category of the manpower matrix. The remaining 191 (1 percent) were placed in Noncare activities.

PODIATRISTS

The National Center for Health Statistics (NCHS) conducted a survey in 1970[14] which served as the basis for the allocation of podiatrists to care categories. Of the estimated 7,110 active podiatrists in 1970, 99.5 percent were reported to be engaged in patient care.

Method of Allocating for Patient Care

The NCHS survey provided information on patients seen in various care settings. This information was used to distribute podiatrists to either Surgical or Outpatient care in short-term hospitals and to Nursing Home care. The remaining podiatrists engaged in patient care were placed in the Podiatric category.

Method for Allocating Nonpatient Care

The 0.5 percent of podiatrists who did not participate in patient care were assigned to Noncare activities.

PHARMACISTS

In 1973, the Bureau of Health Professions supported an inventory of licensed pharmacists conducted by the American Association of Colleges of Pharmacy.

13/ Mount, Henry S., and Hudson, Bettie L. Optometrists Employed in Health Services, United States-1968. DHEW Publication (HRA) 73-1803, Washington: U.S. Government Printing Office, 1973.

14/ Koch, Hugo K. and Phillips, Hazel, M. Characteristics of Patients Treated by Podiatrists, United States-1970. DHEW Publication (HRA) 75-1809. Washington: U.S. Government Printing Office, 1974.

The survey reported on the proportion of pharmacists employed in various settings (community pharmacy, clinic, hospital, nursing home, and other) in 1973. This information, available in unpublished form, was adjusted backwards to estimate the number of active pharmacists in each setting for 1970.

Method for Allocating Hospital-Based Pharmacists

Using data from the 1969 Survey of Health Manpower in Hospitals,[15] hospital-based pharmacists were assigned to short- and long-term hospitals and within long-term hospitals to the Psychiatric and Other care categories. Since no data were available on the breakdown of pharmacists by care categories in short-term hospitals, pharmacists in that setting were arbitrarily assigned 50 percent to Outpatient care, 25 percent to Surgical care, and 25 percent to Medical care.

Method for Allocating Other Non-Hospital Based Pharmacists

Using unpublished data from the 1973 AACP inventory, pharmacists employed in nursing homes were allocated to the Nursing Home category; those in community pharmacies and clinics were assigned to the Pharmacy services category; while those reported to be in other activities were placed under Noncare activities.

VETERINARIANS

Veterinarians were allocated based on a report by the National Academy of Sciences[16] which estimated the number of active veterinarians as of January 1, 1970. In order to estimate the total number of active veterinarians for the end of the year 1970, those entering and leaving the profession during the year were added to and subtracted from the January total. Of the estimated 25,900 total active veterinarians, 6,035 were assigned to Noncare activites based on the proportion of veterinarians reported to be in activities other than the direct care of animals. The remaining 19,865 active veterinarians were assigned to Veterinary care.

REGISTERED NURSES

The Interagency Committee on Nursing Statistics (ICONS) estimated the number of active registered nurses (RNs) at 750,000 as of January 1, 1971.

15/ Losee and Altenderfer, op. cit.

16/ National Research Council, Committee on Veterinary Medical Research and Evaluation. New Horizons for Veterinary Medicine. Washington: National Academy of Sciences, 1972.

Information on their care distribution was based on a 1972 inventory conducted by the American Nursing Association.[17]

Method for Allocating Office-Based RNs

The number of RNs employed in medical office settings was estimated at 51,300. Using the 1972 Profile of Medical Practice[18] the average number of FTE RNs per MD was obtained for each separate specialty. Those numbers were then multiplied by the number of MDs in medical office care categories and inflated to include all 51,300 nurses.

Method for Allocating Hospital-Based RNs

Allocation of RNs to short-term and long-term hospitals was based on information from a 1970 American Hospital Association (AHA) survey of hospital nurses.[19]

- For short-term hospitals, the survey supplied information on RNs in inpatient units, operating rooms, outpatient departments, and administration. On the basis of data from the National Center for Health Statistics Hospital Discharge Survey, 45 percent of the RNs in inpatient care were assigned to Surgical care, the remainder to Medical care. Operating room nurses were included in the Surgical category; those in outpatient departments were assigned to Outpatient care. Administrative nurses were prorated across care categories.

- Data from the AHA survey were used to allocate RNs to Psychiatric care and Other care in long-term hospitals.

Method for Allocating Non-Hospital Based RNs

Using data from the 1972 ANA inventory of nurses,[20] nurses classified as private duty nurses, nurses in public health, and industrial nurses were assigned to Other care in the Other Care Setting classification; those engaged in nursing home care were assigned to the Nursing Home category; while those listed in other fields of employment or in nursing schools were assigned to Noncare activities.

17/ Roth, Aleda V., and Walden, Alice R. The Nation's Nurses. 1972 Inventory of Registered Nurses. Kansas City, M, American Nurses Association, 1974.

18/ American Medical Association, Profile of Medical Practice, 1972.

19/ Unpublished data from American Hospital Association 1970 survey of nurses in hospitals.

20/ Roth and Walden, op. cit.

PHYSICIAN EXTENDERS[21]

Data provided by the Office of Special Programs of the Bureau of Health Manpower estimated that there were 200 physician assistants in 1970 and that all worked in medical office settings. Seventy-five percent were estimated to work in Pediatric care, and 25 percent in General care.

Allied Health Professionals

The last group in the health personnel matrix are the allied health professionals. Data on the total numbers of persons in these occupations came for the most part from secondary data reported by the National Center for Health Statistics.[22] The 1969 survey of Health Manpower in Hospitals,[23] served as the chief source for allocating personnel to short- and long-term hospitals. An NCHS study[24] supplied much of the information on personnel in nursing homes.

Administrators

The total number of persons in the occupations which form this category was estimated at 475,100, consisting of 48,200 administrators, program representatives, and management officers; 93,900 business managers; 275,000 receptionists, secretaries and medical assistants; and 58,000 ward clerks.

Method for Allocating Office-Based Administrators

Secretaries and receptionists employed in dentists' and optometrists' offices were placed in Dental care and Vision care, respectively. Secretaries and receptionists in medical offices were allocated to care categories based on

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[21] In 1970, only physician assistants, defined as "an individual who has successfully completed a 2-4 year program in a senior college or university," were included in this category.

[22] National Center for Health Statistics, Health Resources Statistics - Health Manpower and Health Facilities, 1971. Public Health Service Publication No. 1509, 1971 Edition. Washington, D.C., U.S. Government Printing Office, 1972.

[23] Losee and Altenderfer, op. cit.

[24] Van Nostrand, Joan F. Employees in Nursing Homes: United States, April-September, 1968. DHEW Publication No. (HSM) 73-1700. Washington: U.S. Government Printing Office, 1972.

the average number of these workers per physician by specialty as determined by the AMA Profile of Medical Practice for 1972.[25] These workers were then assigned the same care profile as the physicians. The remaining secretaries and receptionists were placed in Other office-based care.

Method for Allocating Hospital-Based Administrators

Administrative personnel were assigned to short- and long-term hospitals based on the 1969 survey of Health Manpower in Hospitals.[26] This study was also used to subdivide administrative personnel in long-term hospitals into Psychiatric and Other care. Where data were not available for assigning administrative personnel to care categories in short-term hospitals, 20 percent of the workers were arbitrarily assigned to Outpatient care and 40 percent each to Surgical and Medical care.

Medical Library Personnel

This classification includes a total of 2,200 medical librarians and 7,300 medical librarian technicians and clerks. The number employed in hospital libraries was obtained from a 1968 survey by the American Hospital Association.[27] Medical library personnel were allocated to short-term hospitals based on the percent of such hospitals reported having a health sciences library.[28] Because suitable data were not available, hospital library personnel were assigned to care categories on an arbitrary basis:

Short-term Hospitals:	20 percent Outpatient
	40 percent Medical
	40 percent Surgical
Long-term Hospitals:	50 percent Psychiatric
	50 percent Other

The remaining medical library personnel were assigned to Noncare activities.

25/ American Medical Association, op. cit.

26/ Losee and Altenderfer, op. cit.

27/ Kronick, David A.; Rees, Alan M.; and Rothenberg, Lesliebeth. "An Investigation of the Education Needs of Health Science Library Manpower, Part V: Manpower for Hospital Libraries." Bulletin of the Medical Library Association; 59: 392-403, July, 1971.

28/ Miller, Jan D. "Health Sciences Libraries in Hospitals." Bulletin of the Medical Library Association; 60: 519-28, 1972.

Medical Records Personnel

The 1969 Survey of Health Manpower in Hospitals was used as the basis for allocating medical records personnel to short- and long-term hospitals. Included in this classification were 11,000 medical record administrators and 42,000 medical record technicians. Medical records personnel in short-term hospitals were arbitrarily assigned to care categories on the same 20:40:40 basis as library personnel. Allocation of medical records personnel to nursing homes was based on the 1968 nursing home survey[29] which reported a total of 2,570 medical record librarians in these facilities. In order to include other medical record personnel in this figure, the number was arbitrarily inflated to 3,000. All other medical record personnel were assigned to the Other care category in the Noncare Settings classification.

Clinical Laboratory Services

Included in this group were 5,000 clinical laboratory scientists, 70,000 medical laboratory technologists, and 65,000 laboratory technicians and assistants. Laboratory personnel were allocated to medical office care categories by determining the average number of laboratory personnel per physician by specialty, based on the AMA Profile of Medical Practice,[30] and then multiplying by the number of physicians within that specialty in each office-based care category. Hospital-based laboratory personnel were assigned to short- and long-term hospitals on the basis of the 1969 hospital survey;[31] those in short-term hospitals were arbitrarily divided 20:40:40 between Outpatient, Medical, and Surgical care, while those in long-term hospitals were allocated equally to Psychiatric and Other care. The remaining laboratory personnel were assigned to Laboratory services.

Dietary Services

Included in this classification were 30,000 dietitians and nutritionists and 17,000 dietary technicians and food service supervisors. Again, the 1969 hospital survey[32] served as the basis for allocating this group to short- and long-term hospitals. Dietary personnel in short-term hospitals were allocated equally to Medical and Surgical care. Data from the 1968 nursing home survey[33] for dietitians were inflated slightly (to account for other

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29/ Van Nostrand, op. cit.

30/ American Medical Association, op. cit.

31/ Losee and Altenderfer, op. cit.

32/ Ibid.

33/ Van Nostrand, op. cit.

types of dietary personnel) and assigned to the Nursing Home care category. All other dietary personnel were arbitrarily divided between Other patient care and Noncare activities.

Radiologic Technology

This group included 75,000 diagnostic, nuclear medicine, and therapeutic technologists and technicians. Radiologic personnel were distributed to medical office care categories in the same manner as that used to distribute clinical laboratory personnel. Radiologic personnel were assigned to hospitals based on the 1969 hospital survey[34/] and all others were placed in Laboratory services.

Therapy Services[35/]

Workers in this classification were assigned to long- and short-term hospitals based on the 1969 hospital survey[36/] and to nursing homes based on the 1968 nursing home survey.[37/] Within the short-term hospital classification, allocation to Outpatient, Surgical and Medical care was on the same 20:40:40 basis assumed elsewhere. All other personnel were assigned to Other patient care in the Other Care Settings Classification.

General Medical Personnel

This classification includes 5,600 ambulance attendants, 10,700 biomedical engineers and technicians, 22,000 health educators, 9,500 electrocardiograph technicians, 3,300 electroencephalograph technicians, 3,600 orthotists and prosthetists, and 23,400 surgical aides. Each of these categories was allocated separately to hospitals, nursing homes, other patient care, and nonpatient care, again using data from the 1969 hospital survey and 1968 nursing home survey and judgment as to where each occupation was likely to be employed.

34/ Losee and Altenderfer, op. cit.

35/ Includes specialists, technicians, and aides engaged in physical therapy (24,000), occupational therapy (15,600), inhalation therapy (14,600), speech therapy (19,000), and medical and psychiatric social work (29,800). Also includes 13,400 vocational rehabilitation counselors and 11,300 specialized rehabilitation personnel (correction, educational, music, etc.).

36/ Losee and Altenderfer, op. cit.

37/ Van Nostrand, op. cit.

Nursing Care Personnel

This classification included 400,000 licensed practical and vocational nurses; 850,000 nursing aides, orderlies, and attendants; and 17,000 home health aides. Licensed practical nurses were allocated to care categories in medical offices on the basis of the average number of LPNs per physician in different specialties[38] and the number of physicians per specialty in each separate care category. RNs and aides were allocated to hospitals and nursing homes on the basis of the 1969 hospital survey and the 1968 nursing home survey, respectively. A few home health aides were allocated to outpatient services in short-term hospitals on the basis of the proportion of home health agencies which were hospital-based as reported by the National Center for Health Statistics.[39] The remaining home health aides, and the remaining LPN's employed in private homes, schools, and public health agencies, were allocated to Other care in the Other Settings classification.

Vision Care Personnel

This classification included 15,000 ophthalmic assistants, 450 orthoptists, 4,500 optometric assistants, 800 optometric technicians, and 11,000 opticians. All were allocated to Vision care.

Pharmacy Personnel

This classification included 60,200 pharmacy assistants and aides. The allocation to hospitals and nursing homes was made on the basis of unpublished data obtained from the 1973 inventory of licensed pharmacists conducted by the American Association of Colleges of Pharmacy for the Bureau of Health Professions. The remaining pharmacy assistants and aides were allocated to pharmacy services.

Dental Care Personnel

This classification included 15,000 dental hygenists, 112,000 dental assistants, and 30,670 dental technicians.[40] Allocations to short-term and long-term hospitals were made on the basis of the 1969 hospital survey; all other dental care personnel were placed in Dental care.

38/ AMA, op. cit.

39/ National Center for Health Statistics, Health Resources Statistics, Health Manpower and Health Facilities, 1971. PHS Publication No. 1509, 1971 edition. Washington: U.S. Government Printing Office, 1972.

40/ These estimates were provided by the Division of Dentistry, Bureau of Health Professions.

APPENDIX II

OPERATION OF THE MODEL

The procedural steps involved in the application of the BHPr general requirements model fall into two categories. First there are the steps required to develop the data sets which provide the necessary input to the model--the estimates of base year personnel, estimates of base and future year population, and so on. Then there are the steps which act upon those inputs to produce the desired output--future personnel requirements.

The model actually involves three separate computer programs, each with its own set of inputs and outputs. The programs in question--MAIN, PRICE, and NHI--interact in the manner shown in figure 1.

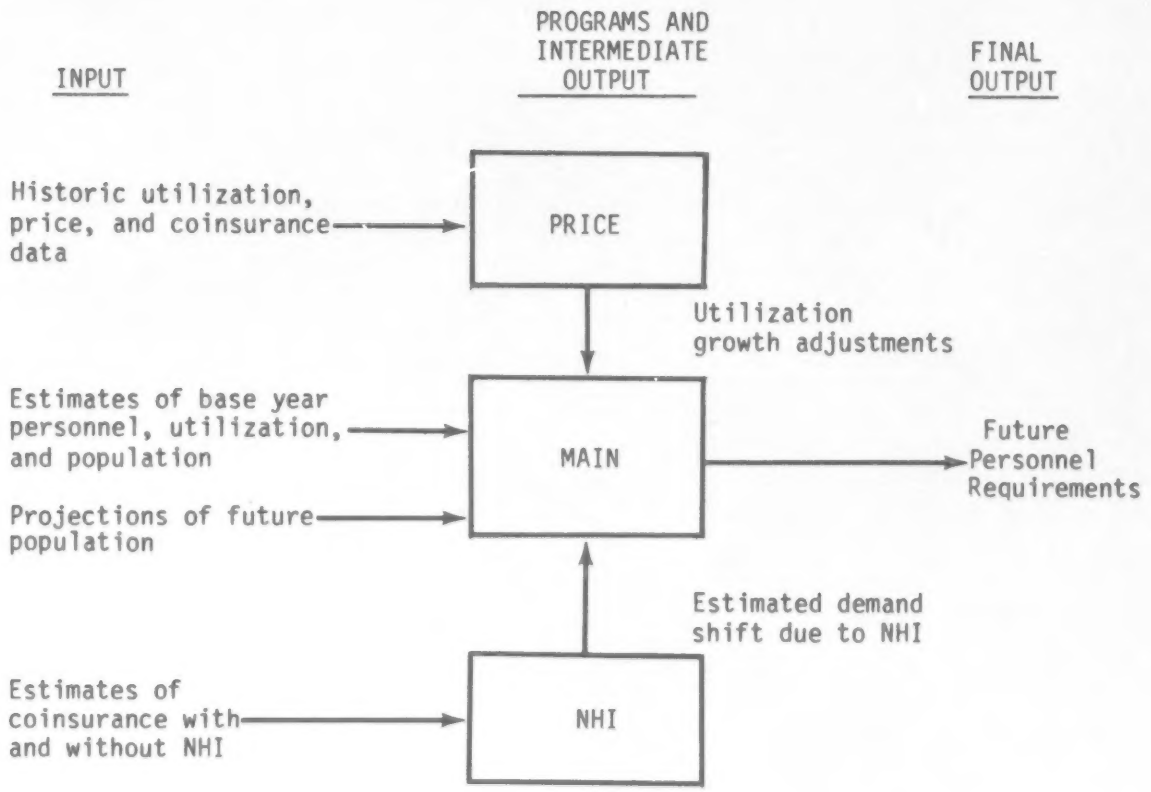
The MAIN program, it will be seen, lies at the heart of the model; the others serve simply to produce intermediate outputs which then serve as input to MAIN.

The primary data sets which feed the model are those shown in the left-hand portion of figure 1. As stated in the preceding section, each of those data sets is developed "off-line," i.e., apart from the model itself, and then is preserved for use as input. The data sets in question, and the mnemonics used in this section in referring to them, are as follows:

Input Data Set	Associated Mnemonic
MAIN Program:	
Personnel matrix for 1975[1/]	MPWR (1975)
Utilization matrix for 1975	UTIL (1975)
Population matrix for 1975	POP (1975)
Population matrices for future years	POP (1980, 1985,...)
(NOTE: In the event the HMO option is selected, the above inputs are specified for the HMO population as well.)	
PRICE Submodel:	
Historic utilization data through 1976, by care category	HISTUTIL
Historic price data through 1976, by care category	PRICE
Historic coinsurance data through 1976, by care category	COINS

1/ The year "1975" and the term "base year" are used synonymously in this discussion.

Figure 1
Schematic of model operation



Input Data Set	Associated Mnemonic
NHI Submodel:	
Estimates of coinsurance rates under NHI, by care category, income, and age[2/]	COINS (NHI)
Estimates of coinsurance rates in the absence of NHI, by care category, income, and age, for 1980	COINS (1980)
Estimated adjustments to non-NHI coinsurance rates in future years	COADJ (1985, 1990,...)

These are not the only inputs to the model but they are the major ones. Other model inputs, reflecting contingencies such as task delegation and technological innovations, are handled as direct adjustments either to future personnel or utilization growth in a manner to be described.

A non-technical description of the three major program components of the model is presented in the discussion which follows.

Main Program

The MAIN program consists of a series of five separate program modules, fully link-edited, each with its own set of inputs and intermediate (or final) output. As shown in figure 2, the first two modules are concerned with the calculation of utilization growth, the last three with personnel.

All told, the five program modules produce a total of 14 output tables. Printout of any or all of these tables may be suppressed at the option of the user. In addition, the model has the capability of bypassing any of the modules, except Module 5, by accessing data sets previously generated at a lower order and preserved. Thus, utilization growth factors previously produced by Program Module 1 (and stored) may be invoked by the user as direct input to Module 2, obviating the necessity for executing the earlier module each time the program is run.

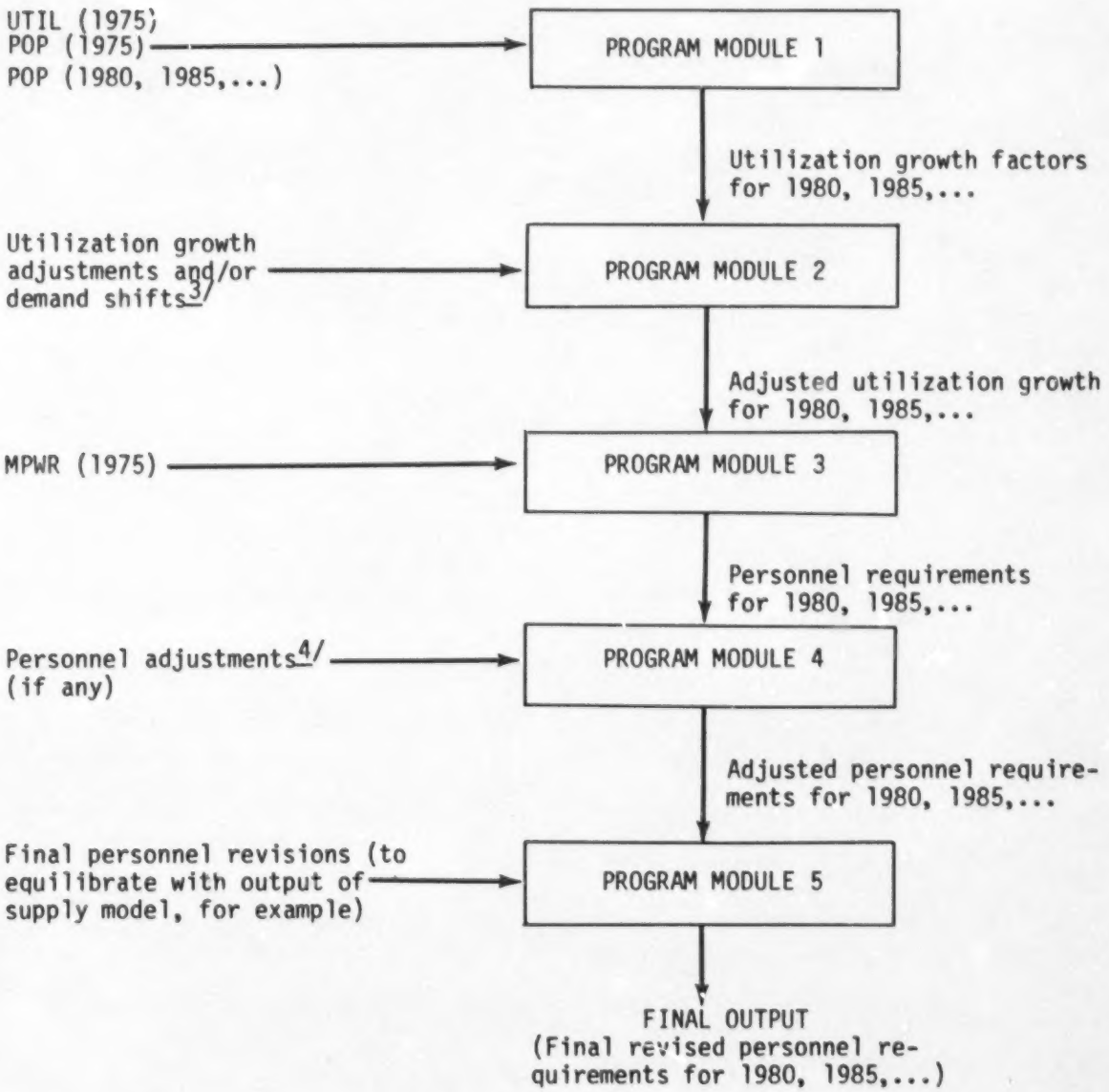
A more explicit description of the input data requirements, processing steps, and output tables associated with each of the five modules is presented below.

Program Module 1. - As stated, the inputs to this model are:

UTIL (1975)	The per capita utilization rates by age, sex, and income, for each separate care category in 1975.

2/ Reflecting the break in coinsurance due to Medicare, only two age cells are employed in the NHI submodel: "under 65" and "65 and over."

Figure 2.
Schematic of main program


UTIL (1975)
POP (1975)
POP (1980, 1985,...)
PROGRAM MODULE 1
Utilization growth factors for 1980, 1985,...
Utilization growth adjustments and/or demand shifts3/
PROGRAM MODULE 2
Adjusted utilization growth for 1980, 1985,...
MPWR (1975)
PROGRAM MODULE 3
Personnel requirements for 1980, 1985,...
Personnel adjustments4/ (if any)
PROGRAM MODULE 4
Adjusted personnel requirements for 1980, 1985,...
Final personnel revisions (to equilibrate with output of supply model, for example)
PROGRAM MODULE 5
FINAL OUTPUT
(Final revised personnel requirements for 1980, 1985,...)

3/ These inputs reflect the output of the PRICE and NHI submodels (see Figure 1). Other contingencies, such as the impact of technological innovation upon utilization, can also be accommodated as input.

4/ These inputs reflect (for example) task delegation, technological innovation, and other contingencies which impact upon personnel.

POP (1975)	The estimated U.S. population, by age, sex, and income, in 1975.
POP (1980, 1985,...)	The projected U.S. population, by age, sex, and income, for future years.

For each age, sex, and income cell (of which there are 40), the program multiplies the per capita utilization in 1975 by the corresponding population projection for each of the years 1975, 1980, etc. The program computes the following products:

UTIL (1975) x POP (1975)

UTIL (1975) x POP (1980)

UTIL (1975) x POP (1985)

.....

Each of these products is a three-way matrix, age by sex by income. The numbers in each matrix represent the projected total utilization, in each year, associated with the members of each separate population cell. The total utilization associated with the population as a whole is then derived by simply summing over all forty cells, for each year. Symbolically:

$$\text{Projected utilization in year } t = \sum_{i=1}^{40} \text{UTIL (1975)} \times \text{POP (t)}$$

Finally, the program calculates utilization growth factors for each of the years 1980, 1985, etc. These growth factors are simply the ratio of the projected utilization for the year in question to that in 1975. Separate growth factors are computed for each separate care category; they represent, as noted earlier, the estimated growth (or decline) in utilization associated solely with population growth and/or shifts in age/sex/income distribution.

The output tables associated with Program Module 1 are as follows:

Table	Description	Years to Which Applicable
T11	Estimated U.S. population by age, sex, and family income.	1975; 1980, 1985,...
T12	Per capita utilization rates (1975) by age, sex, family income and form of care.	1975
T13	Total care utilization by form of care and age.	1975; 1980, 1985,...
T14	Ratio of total care utilization, by form of care, to total care utilization in 1975.	1980, 1985,...

Tables T11 and T12 are simply restatements, in tabular form, of the input data sets POP (1975, 1980...) and UTIL (1975) respectively. Cell-by-cell multiplication of the entries in those tables, followed by a summation over all incomes and both sexes, produces the intermediate Output Table T13.

Program Module 2. - The inputs to this module, as shown previously in Figure 2, consist of:

GROWTH (1980, 1985,...)	The projected growth in care utilization, for each separate care category, as calculated in Program Module 1.
MOD (1980, 1985,...)	A set of separately calculated growth adjustments for each separate care category. These might, for example, represent the output of the PRICE and/or NHI submodels (to be described), or they might be chosen to reflect other postulated changes in per capita utilization[5/]

Each care category will necessarily have an associated value of the variable GROWTH for each separate year. Those values are the values shown in Output Table T14. In addition, each care category may be assigned one or more values of the variable MOD for each year.

Program Module 2 simply adjusts the raw utilization growth estimated for each care category ("GROWTH") by multiplying that value, in turn, by each of the separate adjustment factors ("MOD") associated with that category. The output of that process, for the year 1980, is illustrated for the general population in Table T21. This table is also produced for the HMO population. The process is, of course, repeated for each subsequent year of interest.

Output Table T22 summarizes the bottom line results of the preceding process.

5/ The user of the model might, for example, wish to reflect recent trends in optometric care, podiatric care, or other care sectors not specifically treated in either the PRICE or NHI submodels.

Program Module 3. - The inputs to this module (see Figure 2) are:

ADJGRO (1980, 1985,...	Adjusted utilization growth factors, for each separate care category, resulting from the calculations performed in Program Module 2.
MPWR (1975)	The baseline personnel staffing, by care category and personnel type, in 1975.

Two separate output tables are produced:

- Output Table T31 is the input personnel matrix, MPWR (1975). This is identical to Table 6 on page above.
- Output Table T32 is obtained by multiplying each element in the matrix MPWR (1975) by its corresponding adjusted growth factor ("ADJGRO"). Again, the process is repeated for the HMO sector and for each subsequent year of interest.

The values shown in Table T32 denote the projected personnel requirements associated with that particular year, resulting purely from projected changes in utilization. Those changes, as previously noted, might be a consequence of any number of factors, for example:

- Growth and/or shifts in population (Program Module 1).
- A continuation of historic utilization trends (computed in PRICE submodel, later input to Program Module 2).
- Demand shifts due to National Health Insurance (computed in NHI submodel, later input to Program Module 2).
- Any other numeric adjustments in utilization which the user of the model wishes to postulate (direct input to Program Module 2).

Program Module 4. - Module 4 addresses, for the first time, the issue of productivity adjustment. It provides the user with the capability of modifying personnel requirements in response to postulated contingencies. The specific modifications, however, are calculated offline and introduced in the form of simple numeric statements.

The input specifications are straightforward. For each personnel category to be adjusted, the user may specify either (i) the number of members of that category to be added or subtracted, or (ii) the percentage by which that category is to be increased or decreased. This may be done for any or all personnel types with respect to any or all forms of care. The user has total control over these inputs; the program exercises no check to assure that the inputs are reasonable or even consistent.

The output of this process is illustrated in Output Table T41. This table indicates the (hypothetical) reductions in numbers of general, pediatric, and ob-gyn physicians resulting from the expanded use of physician and dental extenders. Although not illustrated, the program also shows, separately, the increase in physician (including dental) extenders needed to effect those reductions. These numbers, it is emphasized, are purely hypothetical; the portion of the table which pertains to pediatricians is reproduced for purposes of illustration. Similar adjustments may be made for the HMO sector and for other years.

Output Table T42 consolidates the results of the preceding adjustments into a personnel requirements table. It is identical in format to Table T32 above. As before, separate tables are produced for the general and HMO sectors and for each year for which projections are desired.

Program Module 5. - The final module in the MAIN program performs a variety of optional summarizations. First, it can be used to adjust the estimated personnel in 1975 to correspond (for example) to the baseline (1975) estimates produced by the BHPr supply model. That adjustment takes the form of specifying the values to which the estimated personnel figures are to be equated. The output of that process is shown in Table T51.

The next stage, if the user desires, is Output Table T52M which shows both the basic and revised personnel figures for each of the years of interest. Separate tables are produced for the general population, the HMO sector, and the two sectors combined. Shown in each table is the percentage change between 1975 and 1990.

Finally, module 5 produces--if desired--Table T53C, which shows the total member of health professionals of all types combined, broken down by the form of care in which they are engaged. These tables are available for the general, HMO, and total populations respectively.

PRICE submodel. - This submodel serves to operationalize the utilization trend analysis. The inputs involved fall into two categories:

- Input data sets which contain the relevant historic data needed for the calculation and projection of trends.
- Run instructions which define the necessary parameters and assumptions to be employed in the trend calculation and projection process.

Input data sets. - A separate data set is required for each separate form of care which the user wishes to include in the analysis. Currently, the Division of Health Professions Analysis maintains data sets for the four broadly generic forms of care:

- Physician office services.
- Short-term hospital services.
- Dental office services.
- Community pharmacy services.

Each data set consists of historic utilization data (HISTUTIL), price data (PRICE), and coinsurance data (COINS) applicable to that particular form of care through 1976. The specific data elements involved are as follows:

- HISTUTIL - Contains utilization data, as shown below:

Forms of Care	Units in Which Utilization is Expressed	Years For Which Data Are Maintained
Physician office	Visits per year	1966-1976
Short-term hospital	Admissions per year	1950-1976
Dental office	Visits per year	1968-1976
Community pharmacy	Prescriptions per year	1961-1976

The data in question cover the U.S. resident civilian population as a total entity and are not broken down by age, sex, or income.

- PRICE - Contains two elements:

  (a) The Consumer Price Index (CPI) for all items, on a year-by-year basis.

  (b) The year-by-year CPI for the particular form of health care included in the analysis.

- COINS - Contains the Division of Health Professions Analysis' "best estimate" of the average coinsurance rate for that particular form of care. These figures are expressed as gross nationwide averages integrated over all population segments (insured and uninsured alike). As with HISTUTIL and PRICE, coinsurance data are maintained on a year-by-year basis.

Also included in each data set is the estimated resident civilian population for each year.

Run instructions. - To implement a given computer run, the following additional inputs are required for each form of care:

- The desired "start" and "stop" years for the data to be used in the trend analysis. (may be varied; i.e., not all years for which data are available need to be included.)

- Any intervening years which, for whatever reason, the user wishes to exclude.

- A "low" and a "high" value of price elasticity.

- The desired form of fit for the coinsurance trend computations may be either "linear" or "logit."

- The assumed form of the demand-price relationship for that particular form of care may be "double-log" (usual), "semi-log", or "linear."

Operational sequence. - Based on the foregoing inputs, the program performs the following series of steps:

Step 1. - The overall utilization for each year (HISTUTIL) is divided by the population for that year to arrive at the estimated (unadjusted) per capita utilization rate.

Step 2. - The program then divides the CPI for the given form of care by the CPI for all items combined to arrive at the "price" component of the net price to the consumer. That component is P_x. Again, this is done separately for each year.

Step 3. - The value of P_x derived in Step 2 is then multiplied by the corresponding coinsurance rate (I_x) to arrive at the net price to the consumer for that year.

Step 4. - The net price to the consumer (NPC) derived in Step 3 is then applied to the assumed form of the demand-price relationship to arrive at an estimated price-related adjustment factor, F_p, for that year. In the case, for example, of an assumed double logarithmic relationship,

$$F_p = (NPC)^n$$

where n is the assumed elasticity coefficient for that particular form of care.

Step 5. - The per capita utilization rate for each year (Step 1) is then divided by the corresponding price-related adjustment factor (Step 4) to arrive at a price-adjusted (i.e., nonprice-related) utilization rate for the years in question.

Step 6. - The price-adjusted utilization rates derived in Step 5 are then used to generate a linear least squares regression equation. The resulting regression line is then extrapolated ahead to yield projected nonprice-related utilization rates for the future years of interest.

Step 7. - The historic values of P_x (Step 2) are projected forward in time using linear least squares regression.

Step 8. - The historic values of coinsurance (I_x) are projected forward in time using either a linear or logit fit, as specified.

Step 9. - The projected values of P_x and I_x are multiplied, year by year, to yield the estimated net price to the consumer in the years ahead. Those values are then applied to the appropriate demand-price relationship (as in Step 4) to obtain projected price-related adjustment factors for each year.

Step 10. - The price-related adjustment factors derived in Step 9 are then multiplied by the nonprice-related utilization rates derived in Step 6 to yield the projected (price-adjusted) per capita utilization rates for the years of interest.

Output. - The per capita utilization rates derived in Step 10, divided by the corresponding rates applicable in 1975, constitute the essential output of the PRICE submodel and are preserved for use in the MAIN program. Each such ratio, as noted earlier, denotes the projected utilization growth, by year and by form of care, associated with (a) projected price changes and (b) other, nonprice-related factors which influence per capita utilization.

NHI Submodel

This submodel operates, in a manner similar to that just described, to produce utilization adjustment factors which may be used as input to the MAIN program.

Input. - As stated earlier, inputs to the NHI submodel include:

COINS (NHI)	- The coinsurance rates postulated to be applicable under NHI, by care category, income, and age ("under 65" and "65 and over")
COINS (1980)	- Estimates of the coinsurance rates likely to be applicable, in the absence of NHI, in 1980
COADJ (1985,...)	- Projected adjustments (declines) in non-NHI coinsurance in the years subsequent to 1980

Both of the latter inputs (i.e., COINS and COADJ) are the average values predicted, for a given form of care, in the PRICE submodel.

Each data set consists of eight entries (four income categories times two age groupings) for as many care categories as are postulated to come under National Health Insurance.

Other user-specified inputs include, as in the PRICE submodel, two values of elasticity--one high and one low. Additionally, the NHI submodel makes use of the data sets UTIL (1975), POP (1975), and POP (1980, 1985, ...) used in the MAIN program.

Operational sequence. -The program steps are as follows:

Step 1. - For each population cell (of which there are eight), the program computes the demand shift in 1980 due to NHI. This is done separately for each care category, using the following formulations:

Form of Assumed Demand-Price Relationship	Corresponding Expression for Demand Shift
Linear	$1 + n(S-1)$
Semi-log	$e^{n(S-1)}$
Double log	$(S)^n$

where n is the assumed elasticity coefficient and S is the computed ratio of COINS (NHI) to COINS (1980) for the given care category.

Step 2. - The demand shifts calculated in Step 1 are then applied to the corresponding cells in UTIL (1975), the per capita utilization matrix by age, sex, and income in 1975. This process results in an adjusted utilization matrix in which the per capita utilization rates are (generally) higher than in the original.

Step 3. - Each of the utilization rates in the adjusted matrix is then multiplied by its counterpart in the population matrix POP (1980), to obtain the projected total utilization for that population cell. Summing over all population cells produces the overall projected demand shift in 1980 as a consequence of NHI.6/

Step 4. - Steps 1 through 3 are repeated for each of the years 1985, ..., using the coinsurance adjustments COADJ (1985,...) applicable to those years. That is to say, in Step 1

$$S = \frac{\text{COINS (NHI)}}{\text{COINS (1980)} * \text{COADJ (1985,...)}}$$

Since the coinsurance adjustments are generally less than 1.0 (denoting a continuing decline in coinsurance), the values of S in 1985 and subsequent years greater than they were in 1980. As a consequence, the projected demand shift in those later years is less.

6/ Note that the UTIL matrix contains 40 cells while the NHI submodel recognizes only eight. Each NHI data element applicable to those under 65 is in effect applied eight times--to both males and females and to those under 14, 14-24, 25-44, and 45-64 respectively. Each data element applicable to those 65 and over is applied twice--to both males and females. In this manner, two data elements suffice to accommodate 10 cells in the UTIL matrix. Repeating this process four times (once for each income grouping) serves to close the gap.

Output. - As in the case of the PRICE submodel, the NHI output is preserved for use as utilization adjustment factors in Program Module 2 of the MAIN program. The output consists, simply, of the projected demand shifts due to NHI, by care category and year, integrated over all age, sex, and income cells.

T11. Total population by age, sex, and family income level: 1990

SEX AND AGE	ALL INCOMES	UNDER $5000	$5000-$9999	$10000-$14999	$15000 & OVER
ALL PERSONS					
TOTAL	235602	20350	34387	44025	136840
UNDER 14	45721	2602	7998	9625	25496
14-24	37646	2447	5244	6911	23044
25-44	77607	3270	12099	16621	45617
45-64	45694	3374	5942	8135	28243
65 & OVER	28934	8657	3104	2733	14440
MALE					
TOTAL	114290	8166	16452	21520	68152
UNDER 14	23420	1487	3975	4777	13181
14-24	19053	1228	2428	3412	11985
25-44	38326	1258	5967	8204	22897
45-64	21973	938	2690	4117	14228
65 & OVER	11518	3255	1392	1010	5861
FEMALE					
TOTAL	121312	12184	17935	22505	68688
UNDER 14	22301	1115	4023	4848	12315
14-24	18593	1219	2816	3499	11059
25-44	39281	2012	6132	8417	22720
45-64	23721	2436	3252	4018	14015
65 & OVER	17416	5402	1712	1723	8579

T12. General care utilization rates by population category and by type of care (visits/year)

POPULATION AGE, SEX, AND FAMILY INCOME	MEDICAL OFFICE					SHORT-TERM HOSP			LONG-TERM HOSP	
	GENERAL CARE 01	PEDIATRIC CARE 02	OB-GYN CARE 03	PSYCH CARE 04	OTHER CARE 05	OUT PT. CARE 06	SURG CARE 07	MEDICAL CARE 08	PSYCH CARE 09	OTHER CARE 10
INCOME UNDER $5000										
MALE										
UNDER 14	3.1658	1.2767			.6328	.5532	.0398	.0725	.0006	1.0000
14-24	2.1425	.0293		.0289	1.0094	.3444	.0363	.0296	.0032	1.0000
25-44	3.7202		.0270	.3343	2.1260	1.7019	.0552	.0875	.0048	1.0000
45-64	4.1271	.0239		.1155	1.7225	.8141	.0836	.2021	.0036	1.0000
65 & OVER	4.0878			.0191	1.3774	.5257	.1132	.1556	.0019	1.0000
FEMALE										
UNDER 14	2.7652	1.6267	.0264		.6438	.5423	.0328	.0439	.0003	1.0000
14-24	4.0259	.0495	1.0884	.1416	.9361	.8770	.1518	.0665	.0017	1.0000
25-44	4.6231	.0492	.9140	.3342	1.5026	1.0170	.1609	.1175	.0032	1.0000
45-64	5.7642		.2287	.1834	1.8506	.7069	.0887	.1407	.0027	1.0000
65 & OVER	5.1745	.0073	.1009	.0136	1.1413	.2138	.0857	.1483	.0012	1.0000
INCOME $5000-9999										
MALE										
UNDER 14	2.1999	1.4319	.0319	.0101	.6311	.5197	.0359	.0516	.0006	1.0000
14-24	2.5307	.0786		.0585	.7547	.4578	.0483	.0266	.0032	1.0000
25-44	1.7948		.0489	.0688	.9465	.3188	.0400	.0533	.0048	1.0000
45-64	3.8789		.0116	.0257	1.3315	.6071	.0837	.1227	.0036	1.0000
65 & OVER	5.1792			.0629	1.6315	.8273	.1278	.1296	.0019	1.0000
FEMALE										
UNDER 14	1.9695	1.6259			.4273	.4707	.0257	.0434	.0003	1.0000
14-24	3.0999	.0784	1.6709	.0529	.7405	.6388	.1588	.0545	.0017	1.0000
25-44	3.9169	.0435	1.3986	.1699	1.2601	.7667	.1693	.0751	.0032	1.0000
45-64	4.8997		.1924	.0360	1.0741	.5539	.0837	.1001	.0027	1.0000
65 & OVER	5.1712		.0876	.0754	1.2931	.2991	.0848	.1219	.0012	1.0000
INCOME $10000-14999										
MALE										
UNDER 14	2.2505	2.2060	.0228	.0078	.4270	.3180	.0424	.0327	.0006	1.0000
14-24	1.8593	.0527	.0097		.9111	.1990	.0347	.0332	.0032	1.0000
25-44	2.1817	.0060	.0289	.0592	.9982	.2153	.0457	.0414	.0048	1.0000
45-64	3.0054		.0186	.0108	1.3335	.7028	.0740	.0764	.0036	1.0000
65 & OVER	5.0886				1.2814	.5472	.1063	.1940	.0019	1.0000
FEMALE										
UNDER 14	1.6192	2.0807	.0153	.0182	.4543	.2820	.0289	.0346	.0003	1.0000
14-24	3.0232	.1279	1.1763	.0212	.7207	.3069	.1220	.0387	.0017	1.0000
25-44	3.5083	.0240	1.5604	.0434	.9818	.4664	.1467	.0567	.0032	1.0000
45-64	4.6627		.4073	.0399	1.1917	.5324	.0985	.0775	.0027	1.0000
65 & OVER	5.0806		.0401		1.8805	.6909	.0845	.1403	.0012	1.0000
INCOME $15000 & OVER										
MALE										
UNDER 14	1.8938	2.6789	.0052		.6472	.2122	.0389	.0337	.0006	1.0000
14-24	2.2437	.2234	.0163	.0557	.8604	.2270	.0370	.0250	.0032	1.0000
25-44	2.5291	.0079	.0243	.0689	.9564	.1622	.0383	.0303	.0048	1.0000
45-64	3.2291	.0048	.0105	.1000	1.1093	.2800	.0659	.0697	.0036	1.0000
65 & OVER	4.9473			.0495	1.4865	.6363	.0774	.1002	.0019	1.0000
FEMALE										
UNDER 14	1.5695	2.0782	.0106	.0674	.5041	.2104	.0293	.0186	.0003	1.0000
14-24	2.7089	.2438	.8316	.0569	.8887	.1921	.0727	.0278	.0017	1.0000
25-44	3.3537	.0425	1.5768	.1916	1.1147	.3406	.1342	.0487	.0032	1.0000
45-64	3.7725	.0336	.5836	.1112	1.4434	.4505	.0885	.0610	.0027	1.0000
65 & OVER	4.3464		.0702	.0715	.6618	.1868	.1108	.1168	.0012	1.0000

T12 GENERAL CARE UTILIZATION RATES BY POPULATION CATEGORY AND BY TYPE OF CARE (VISITS/YEAR)

POPULATION AGE, SEX, AND FAMILY INCOME	OTHER CARE				OTHER					
	NURSING HOME 11	VISION CARE 12	DENTAL CARE 13	VET CARE 14	OTHER CARE 15	LAB SERV 16	PHARM SERV 17	NON-CARE ACT 18	OPT. CARE 19	POD. CARE 20
INCOME UNDER $5000										
MALE										
UNDER 14		.0399	.7984	1.0000	1.0000	1.0000	3.1358		.0419	.0113
14-24		.0854	1.3485	1.0000	1.0000	1.0000	2.3647		.1322	.0070
25-44		.0354	1.3210	1.0000	1.0000	1.0000	4.1008		.0913	.0117
45-64	.0025	.0965	1.2758	1.0000	1.0000	1.0000	10.9533		.1019	.0139
65 & OVER	.0290	.1365	.6597	1.0000	1.0000	1.0000	10.9902		.1161	.0329
FEMALE										
UNDER 14		.0550	.7752	1.0000	1.0000	1.0000	2.9151		.0630	.0085
14-24		.1055	1.3987	1.0000	1.0000	1.0000	5.7524		.1391	.0117
25-44		.0849	1.3238	1.0000	1.0000	1.0000	8.7136		.0995	.0250
45-64	.0027	.3311	1.2781	1.0000	1.0000	1.0000	12.5252		.1665	.0394
65 & OVER	.0526	.2043	.6897	1.0000	1.0000	1.0000	14.2299		.1214	.0663
INCOME $5000-9999										
MALE										
UNDER 14		.0627	.8823	1.0000	1.0000	1.0000	3.0999		.0526	.0067
14-24		.1207	1.3808	1.0000	1.0000	1.0000	1.9041		.1095	.0097
25-44		.1055	1.0039	1.0000	1.0000	1.0000	3.2832		.0898	.0090
45-64	.0025	.0917	1.1664	1.0000	1.0000	1.0000	7.3237		.1506	.0194
65 & OVER	.0290	.2978	1.4904	1.0000	1.0000	1.0000	10.9416		.1409	.0491
FEMALE										
UNDER 14		.0394	.9564	1.0000	1.0000	1.0000	2.9375		.0566	.0051
14-24		.0591	1.9562	1.0000	1.0000	1.0000	4.9203		.1444	.0093
25-44		.0669	1.3964	1.0000	1.0000	1.0000	6.8197		.1301	.0125
45-64	.0027	.1310	1.5439	1.0000	1.0000	1.0000	9.7670		.1603	.0484
65 & OVER	.0526	.1874	1.0857	1.0000	1.0000	1.0000	13.1549		.1540	.1016
INCOME $10000-14999										
MALE										
UNDER 14		.0270	1.3700	1.0000	1.0000	1.0000	3.1669		.0605	.0151
14-24		.0403	1.3070	1.0000	1.0000	1.0000	1.9694		.1159	.0101
25-44		.0780	1.2391	1.0000	1.0000	1.0000	2.9413		.0992	.0110
45-64	.0025	.1364	1.2029	1.0000	1.0000	1.0000	5.7852		.1483	.0182
65 & OVER	.0290	.1810	1.8345	1.0000	1.0000	1.0000	9.0405		.1736	.0422
FEMALE										
UNDER 14		.0353	1.4055	1.0000	1.0000	1.0000	3.2029		.0766	.0147
14-24		.0409	2.3071	1.0000	1.0000	1.0000	4.8652		.1725	.0112
25-44		.1232	1.8999	1.0000	1.0000	1.0000	7.2595		.1416	.0097
45-64	.0027	.1473	1.9393	1.0000	1.0000	1.0000	8.3985		.2126	.0485
65 & OVER	.0526	.2493	.9246	1.0000	1.0000	1.0000	12.7444		.1777	.0981
INCOME $15000 & OVER										
MALE										
UNDER 14		.0641	1.8644	1.0000	1.0000	1.0000	3.6374		.0809	.0100
14-24		.0712	2.2018	1.0000	1.0000	1.0000	2.3427		.1204	.0104
25-44		.0683	1.8250	1.0000	1.0000	1.0000	3.4810		.1255	.0142
45-64	.0025	.1656	1.9341	1.0000	1.0000	1.0000	5.2895		.1782	.0285
65 & OVER	.0290	.1163	2.0896	1.0000	1.0000	1.0000	10.3168		.1675	.0466
FEMALE										
UNDER 14		.1041	1.9547	1.0000	1.0000	1.0000	3.4837		.0822	.0081
14-24		.0838	2.6963	1.0000	1.0000	1.0000	4.1653		.1901	.0136
25-44		.1324	2.0893	1.0000	1.0000	1.0000	6.9528		.1573	.0279
45-64	.0027	.2245	2.5072	1.0000	1.0000	1.0000	7.8923		.2186	.0797
65 & OVER	.0526	.4777	1.7030	1.0000	1.0000	1.0000	10.8600		.1341	.1194

T13. General total care utilization by type of care and population age

T13 GENERAL TOTAL CARE UTILIZATION BY TYPE OF CARE AND POPULATION AGE
(IN 1000'S)

POPULATION AGE	OTHER CARE				OTHER					
	NURSING HOME 11	VISION CARE 12	DENTAL CARE 13	VET CARE 14	OTHER CARE 15	LAB SERV 16	PHARM SERV 17	NON-CARE ACT 18	OPT. CARE 19	POD. CARE 20
1975										
TOTAL	1075	23503	340882	213032	213032	213032	1214896		27099	5126
UNDER 14		2783	67604	49321	49321	49321	160500		3322	494
14-24		3305	85312	44267	44267	44267	153774		6288	470
25-44		5018	87555	53507	53507	53507	283402		6690	847
45-64	113	7452	75857	43534	43534	43534	342977		7694	1793
65 & OVER	962	4945	24554	22403	22403	22403	274243		3105	1522
1980										
TOTAL	1170	25357	368504	220353	220353	220353	1250947		28794	5566
UNDER 14		2639	64934	45090	45090	45090	148251		3117	450
14-24		3271	92030	45194	45194	45194	153600		6533	493
25-44		5897	102035	61858	61858	61858	324566		7805	974
45-64	114	7599	79144	43688	43688	43688	333411		7898	1885
65 & OVER	1056	5951	30361	24523	24523	24523	291119		3441	1764
1985										
TOTAL	1264	27254	393990	228352	228352	228352	1303435		30288	6038
UNDER 14		2756	67108	44453	44453	44453	147949		3155	440
14-24		3072	88759	42222	42222	42222	142433		6173	467
25-44		6837	120669	71176	71176	71176	373443		9140	1175
45-64	114	7784	82244	43842	43842	43842	327435		8055	1969
65 & OVER	1150	6805	35210	26659	26659	26659	312175		3765	1987
1990										
TOTAL	1369	29114	414640	235602	235602	235602	1357640		31557	6523
UNDER 14		2955	71408	45721	45721	45721	153555		3308	448
14-24		2754	80961	37646	37646	37646	126279		5549	421
25-44		7504	134291	77607	77607	77607	407006		10102	1326
45-64	119	8226	87870	45694	45694	45694	335681		8491	2111
65 & OVER	1250	7675	40110	28934	28934	28934	335119		4107	2217

T13. (continued)

POPULATION AGE	MEDICAL OFFICE					SHORT-TERM HOSP			LONG-TERM HOSP	
	GENERAL CARE 01	PEDIATRIC CARE 02	OB-GYN CARE 03	PSYCH CARE 04	OTHER CARE 05	OUT PT. CARE 06	SURG CARE 07	MEDICAL CARE 08	PSYCH CARE 09	OTHER CARE 10
1975										
TOTAL	665664	105117	77330	13928	209994	89341	16071	13401	513	213032
UNDER 14	101078	97756	670	793	26519	17327	1684	1873	22	49321
14-24	117631	5762	25770	2259	37541	16463	3496	1590	109	44267
25-44	161768	1184	40695	6685	59081	23143	5131	2848	213	53507
45-64	174872	368	9042	3369	57465	22683	3559	3973	136	43534
65 & OVER	110315	47	1153	822	29388	9725	2201	3117	33	22403
1980										
TOTAL	679639	100557	84348	14613	216611	86367	16693	13387	551	220353
UNDER 14	89079	91950	592	816	24071	14898	1534	1628	20	45090
14-24	117149	6783	25139	2173	38169	14755	3345	1522	111	45194
25-44	183902	1353	47591	7252	66665	24635	5874	3172	247	61858
45-64	171556	428	9839	3453	57295	21898	3555	3761	137	43688
65 & OVER	117953	43	1187	919	30411	10181	2385	3304	36	24523
1985										
TOTAL	702834	102034	89983	16167	225496	85609	17318	13566	584	228352
UNDER 14	86192	93020	550	897	23988	13883	1514	1540	20	44453
14-24	108526	6890	22610	2066	35835	12943	2997	1373	104	42222
25-44	211458	1591	55130	8478	76297	26864	6674	3530	284	71176
45-64	169309	492	10420	3640	57260	21065	3542	3622	137	43842
65 & OVER	127349	41	1273	1086	32116	10854	2591	3501	39	26659
1990										
TOTAL	725478	106347	93226	17376	233233	85451	17833	13851	610	235602
UNDER 14	87350	97474	538	996	24867	13661	1558	1534	21	45721
14-24	96183	6509	19573	1870	32069	11000	2587	1191	93	37646
25-44	230243	1763	60493	9327	82750	27935	7206	3742	310	77607
45-64	174204	562	11256	3927	59489	21250	3670	3660	143	45694
65 & OVER	137498	39	1366	1256	34058	11605	2812	3724	43	28934

T14. General utilization as a percentage of 1975 by type of care

YEAR	MEDICAL OFFICE					SHORT-TERM HOSP			LONG-TERM HOSP	
	GENERAL CARE 01	PEDIATRIC CARE 02	OB-GYN CARE 03	PSYCH CARE 04	OTHER CARE 05	OUT PT. CARE 06	SURG CARE 07	MEDICAL CARE 08	PSYCH CARE 09	OTHER CARE 10
1980	102.0	95.6	109.0	104.9	103.1	96.6	103.8	99.8	107.4	103.4
1985	105.5	97.0	116.3	116.0	107.3	95.8	107.7	101.2	113.8	107.1
1990	108.9	101.1	120.5	124.7	111.0	95.6	110.9	103.3	118.9	110.5

	OTHER CARE				OTHER					
	NURSING HOME 11	VISION CARE 12	DENTAL CARE 13	VET CARE 14	OTHER CARE 15	LAB SERV 16	PHARM SERV 17	NON-CARE ACT 18	OPT. CARE 19	POD. CARE 20
1980	108.8	107.8	108.1	103.4	103.4	103.4	102.9	100.0	106.2	108.5
1985	117.5	115.9	115.5	107.1	107.1	107.1	107.2	100.0	111.7	117.7
1990	127.3	123.8	121.6	110.5	110.5	110.5	111.7	100.0	116.4	127.2

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T21. General care growth rates by type of care (percent)

1990

	MEDICAL OFFICE					SHORT-TERM HOSP			LONG-TERM HOSP	
	GENERAL CARE 01	PEDIATRIC CARE 02	OB-GYN CARE 03	PSYCH CARE 04	OTHER CARE 05	OUT PT. CARE 06	SURG CARE 07	MEDICAL CARE 08	PSYCH CARE 09	OTHER CARE 10
CARE GROWTH	108.9	101.1	120.5	124.7	111.0	95.6	110.9	103.3	118.9	110.5
MODIFICATION										
01 PRICE=HVAR,INS=LG,MODEL=3	1.5353	1.5353	1.5353	1.5353	1.5353					
02 PRICE=HVAR,INS=LG,MODEL=3						1.4677	1.4677	1.4677		
03 PRICE=HVAR,INS=LN,MODEL=3										
04 PRICE=HVAR,INS=LN,MODEL=3										
05 75 NURSING HOME										
06 75 OPTOMETRY										
07 75 PODIATRY										
40 TOTAL MODIFICATION	1.5353	1.5353	1.5353	1.5353	1.5353	1.4677	1.4677	1.4677	1.0000	1.0000
ADJ. CARE GROWTH	167.2	155.2	185.0	191.5	170.4	140.3	162.8	151.6	118.9	110.5

	OTHER CARE					OTHER				
	NURSING HOME 11	VISION CARE 12	DENTAL CARE 13	VET CARE 14	OTHER CARE 15	LAB SERV 16	PHARM SERV 17	NON-CARE ACT 18	OPT. CARE 19	POD. CARE 20
CARE GROWTH	127.3	123.8	121.6	110.5	110.5	110.5	111.7	100.0	116.4	127.2
MODIFICATION										
01 PRICE=HVAR,INS=LG,MODEL=3		1.5353								
02 PRICE=HVAR,INS=LG,MODEL=3										
03 PRICE=HVAR,INS=LN,MODEL=3			1.2950							
04 PRICE=HVAR,INS=LN,MODEL=3							1.1673			
05 75 NURSING HOME	1.2606									
06 75 OPTOMETRY									1.1181	
07 75 PODIATRY										1.7339
40 TOTAL MODIFICATION	1.2606	1.5353	1.2950	1.0000	1.0000	1.0000	1.1673	1.0000	1.1181	1.7339
ADJ. CARE GROWTH	160.5	190.1	157.5	110.5	110.5	110.5	130.4	100.0	130.1	220.6

TFB1JQC.SOAR.2000.BASE FILE05 1/22/79
TFB1JQC.PRICE.LOG2B.M4E2.HVAR ON FILE05 07-31-80
TFB1JQC.SOAR.PRICE.PHYS.OFF ON FILE05 8/9/78;1/23: UNTRANS YR: 07-31-80 15:45
TFB1JQC.SOAR.PRICE.SHT.STY.HOSP ON FILE05 7/31/78: UNTRANS YR: 07-31-80 15:45
TFB1JQC.SOAR.PRICE.DENTAL ON FILE05 8/2/78;1/23/7: UNTRANS YR: 07-31-80 15:45
TFB1JQC.SOAR.PRICE.RX ON FILE05 7/31/78;1/23/79PP: UNTRANS YR: 07-31-80 15:45
TFB1JQC.SOAR.UTIL.ADJ ON FILE05 6/26/78
80B (SAVED AS TFB1JQC.NHI.80B ON FILE05)
(NHI PLAN STIPULATES AVERAGE 10% COINSURANCE)

T22. General adjusted growth rate by type of care

YEAR	MEDICAL OFFICE					SHORT-TERM HOSP			LONG-TERM HOSP	
	GENERAL CARE 01	PEDIATRIC CARE 02	OB-GYN CARE 03	PSYCH CARE 04	OTHER CARE 05	OUT PT. CARE 06	SURG CARE 07	MEDICAL CARE 08	PSYCH CARE 09	OTHER CARE 10
1980	117.6	110.2	125.7	121.0	118.9	111.8	120.2	115.5	107.4	103.4
1985	140.0	128.7	154.3	153.9	142.4	125.1	140.6	132.1	113.8	107.1
1990	167.2	155.2	185.0	191.5	170.4	140.3	162.8	151.6	118.9	110.5

	OTHER CARE				OTHER					
	NURSING HOME 11	VISION CARE 12	DENTAL CARE 13	VET CARE 14	OTHER CARE 15	LAB SERV 16	PHARM SERV 17	NON-CARE ACT 18	OPT. CARE 19	POD. CARE 20
1980	119.8	124.3	116.7	103.4	103.4	103.4	107.0	100.0	111.1	135.6
1985	140.1	153.8	136.1	107.1	107.1	107.1	117.2	100.0	120.6	175.3
1990	160.5	190.1	157.5	110.5	110.5	110.5	130.4	100.0	130.1	220.6

T32. General projected health manpower requirements by type and type of occupation: 1990

		TOTAL	MEDICAL OFFICE					SHORT-TERM HOSP			LONG-TERM HOSP	
			GENERAL CARE 01	PEDIATRIC CARE 02	OB-GYN CARE 03	PSYCH CARE 04	OTHER CARE 05	OUT PT. CARE 06	SURG CARE 07	MEDICAL CARE 08	PSYCH CARE 09	OTHER CARE 10
ALL MANPOWER TYPES		6993708	252290	83544	84634	39589	402415	275948	1452909	1328999	446865	170559
PHYSICIANS (MD)		537746	77737	33295	30072	28878	130195	11899	103704	54091	11098	3662
GENERAL *	02	183796	60988	14576	5356	2070	45999	7941	2199	32279	3689	1631
PEDIATRIC	03	3246	950	18719			462	895	80	9367		145
OBSTETRICS-GYN	04	37830	4404		23983	151			8394			
OPHTHALMOLOGY	05	20326							3241			
PSYCHIATRY *	06	41781				26536		2450		2110	7409	
SURGERY *	07	124114	5879		733	121	40901		73730			
SECONDARY SPECIALIST *	08	74497	5516				42833	613	7121	9284		1886
NONCARE SPECIALIST *	09	22935							8939	1051		
PHYSICIANS (DO)	10	23346	18512	73	87	67	791	438	414	1834		183
DENTISTS	11	177822							5924		3078	578
OPTOMETRISTS	12	26031										
PODIATRISTS	13	15488						275	389			
PHARMACISTS	14	158723						7993	4637	4318	1955	368
VETERINARIANS	15	34106										
REGISTERED NURSES	16	1396814	33380	13821	15930	1185	47087	48584	442560	410365	40321	17232
PHYSICIAN EXTENDER	17	11017	2327	582	263		704	1994	1035	966	175	78
ALLIED HEALTH MANPOWER		4612615	120334	35773	38282	9459	223638	204765	894246	857425	390238	148458
ADMINISTRATION	19	1028616	87001	27598	29926	9035	142761	55654	172588	160714	97786	25782
MEDICAL LIBRARIAN	20	13363						1233	2860	2664	1206	1120
MEDICAL RECORD	21	92967						12774	29646	27606	10095	2494
CLINICAL LAB	22	267045	14381	2558	2303	33	24810	32392	75175	70003	9197	8547
DIETARY	23	109118							32604	30361	7399	3174
RADIOLOGIC	24	156579	5232	835	764		41699	15085	35009	32600	3995	3713
THERAPY	25	221185						14729	34180	31828	32360	11743
GENERAL MEDICAL *	26	112545					1094	9423	11945	36416	3242	7197
NURSING CARE	27	2137195	13720	4782	5289	391	13274	59186	490650	456895	218142	79703
VISION CARE	28	66535										
PHARMACY	29	133676						3742	8954	8338	1784	1658
DENTAL CARE	30	273791						547	635		5032	3327
HOSPITAL SUPPORT	31											

T32. (continued)

		OTHER CARE				OTHER					
		NURSING HOME 11	VISION CARE 12	DENTAL CARE 13	VET CARE 14	OTHER CARE 15	LAB SERV 16	PHARM SERV 17	NON-CARE ACT 18	OPT. CARE 19	POD. CARE 20
ALL MANPOWER TYPES		877478	105223	477[illegible]	32056	484746	59224	237313	117765	36950	27288
PHYSICIANS (MD)		953	16767			2885	4761		27749		
GENERAL *	02	953							6115		
PEDIATRIC	03								1849		
OBSTETRICS-GYN	04								898		
OPHTHALMOLOGY	05		16767						318		
PSYCHIATRY *	06								3276		
SURGERY *	07								2750		
SECONDARY SPECIALIST *	08								7244		
NONCARE SPECIALIST *	09					2885	4761		5299		
PHYSICIANS (DO)	10		46						901		
DENTISTS	11			164332					3910		
OPTOMETRISTS	12								400	25631	
PODIATRISTS	13	735							37		14052
PHARMACISTS	14	878						128647	9927		
VETERINARIANS	15				32056				2050		
REGISTERED NURSES	16	108740				176332			41227		
PHYSICIAN EXTENDER	17					2873			20		
ALLIED HEALTH MANPOWER		766172	88410	313581		302606	54463	108666	31544	11319	13236
ADMINISTRATION	19	79460	21875	49331		51168				11319	6618
MEDICAL LIBRARIAN	20								4280		
MEDICAL RECORD	21	5815				4537					
CLINICAL LAB	22						27646				
DIETARY	23	23051				10933			1596		
RADIOLOGIC	24						17647				
THERAPY	25	42642				53703					
GENERAL MEDICAL *	26					1772	9170		25668		6618
NURSING CARE	27	614670				180493					
VISION CARE	28		66535								
PHARMACY	29	534						108666			
DENTAL CARE	30			264250							
HOSPITAL SUPPORT	31										

T41. General estimated health manpower requirements: 1980

1980

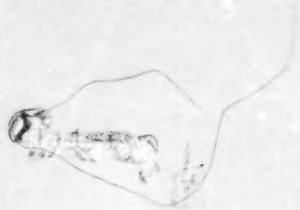
PHYSICIAN EXTENDER 17

	TOTAL	MEDICAL OFFICE					SHORT-TERM HOSP			LONG-TERM HOSP	
		GENERAL CARE 01	PEDIATRIC CARE 02	OB-GYN CARE 03	PSYCH CARE 04	OTHER CARE 05	OUT PT. CARE 06	SURG CARE 07	MEDICAL CARE 08	PSYCH CARE 09	OTHER CARE 10
MANPOWER REQUIREMENTS	8747	1637	413	178		491	1589	764	736	158	73
INTERVENTION											
04 H	13685	634	9522	3529							
17 H	105932										
ADJ. MANPOWER REQUIREMENTS	200092	45965	22162	19514		491	1589	764	736	158	73

	OTHER CARE				OTHER					
	NURSING HOME 11	VISION CARE 12	DENTAL CARE 13	VET CARE 14	OTHER CARE 15	LAB SERV 16	PHARM SERV 17	NON-CARE ACT 18	OPT. CARE 19	POD. CARE 20
MANPOWER REQUIREMENTS					2688			20		
INTERVENTION										
04 H										
17 H			105932							
ADJ. MANPOWER REQUIREMENTS			105932		2688			20		

T51. Computed ratio for manpower change

	GENERAL	H.M.O.	TOTAL 1975	ADJUST.	RATIO
PHYSICIANS (M.D. + D.O.)	354812		354812	378376	1.06641
PHYSICIANS (M.D.'S)	340280		340280	364320	1.07065
PRIMARY CARE	159907		159907	169230	1.05830
GENERAL MEDICINE /1	116430		116430	122190	1.04947
PEDIATRICIANS	21746		21746	24080	1.10733
OBSTETRICS & GYN	21731		21731	22960	1.05656
OPHTHALMOLOGISTS	11129		11129	11750	1.05580
PSYCHIATRISTS	26502		26502	28560	1.07765
SURGEONS 2/	76017		76017	80550	1.05963
SECONDARY CARE	66725		66725	74230	1.11248
SECONDARY SPEC. /3	48322		48322	48450	1.00265
NON-CARE SPEC. /4	18403		18403	25780	1.40086
PHYSICIANS (D.O.'S)	14532		14532	14056	.96724
DENTISTS	114999		114999	112020	.97410
OPTOMETRISTS	20101		20101		1.00000
PODIATRISTS	7300		7300		1.00000
PHARMACISTS	122500		122500		1.00000
VETERINARIANS	31060		31060		1.00000
REGISTERED NURSES	961000		961000		1.00000
PHYSICIAN EXTENDERS	7854		7854		1.00000



T52M. Total projected requirements for MD's by specialty and for DO's and other health providers in 1980, 1985, 1990 compared to current supply

	REQUIREMENTS ESTIMATES							
	1975		1980		1985		1990	
	BASIC	REVISED	BASIC	REVISED	BASIC	REVISED	BASIC	REVISED
PHYSICIANS (M.D. + D.O.)	354812	378376	412018	438833	480637	511297	561092	596214
PHYSICIANS (M.D.'S)	340280	364320	395137	422505	460827	492136	537746	573633
PRIMARY CARE	159907	169230	185280	196034	216575	229119	254093	268810
GENERAL MEDICINE /1	116430	122190	134520	141175	156893	164654	183796	192888
PEDIATRICIANS	21746	24080	24174	26769	27722	30697	32467	35952
OBSTETRICS & GYN	21731	22960	26586	28090	31960	33768	37830	39970
OPHTHALMOLOGISTS	11129	11750	13674	14437	16682	17613	20326	21460
PSYCHIATRISTS	26502	28560	30295	32647	35716	38489	41781	45025
SURGEONS 2/	76017	80550	90436	95829	106236	112571	124114	131515
SECONDARY CARE	66725	74230	75452	83558	85618	94344	97432	106823
SECONDARY SPEC. /3	48322	48450	55597	55744	64273	64443	74497	74694
NON-CARE SPEC. /4	18403	25780	19855	27814	21345	29901	22935	32129
PHYSICIANS (D.O.'S)	14532	14056	16881	16328	19810	19161	23346	22581
DENTISTS	114999	112021	133368	129914	154536	150534	177822	173216
OPTOMETRISTS	20101	20101	22288	22288	24159	24159	26031	26031
PODIATRISTS	7300	7300	9730	9730	12427	12427	15488	15488
PHARMACISTS	122500	122500	131335	131335	143439	143439	158723	158723
VETERINARIANS	31060	31060	32046	32046	33120	33120	34106	34106
REGISTERED NURSES	961000	961000	1095824	1095824	1238507	1238507	1396814	1396814
PHYSICIAN EXTENDERS	7854	7854	8747	8747	9800	9800	11017	11017

1/ INCLUDES GENERAL AND FAMILY PRACTICE, INTERNAL MEDICINE, AND SPECIALTY UNSPECIFIED WHICH ARE ASSUMED TO PREDOMINATELY PROVIDE PRIMARY CARE.
2/ INCLUDES GENERAL SURGERY, NEUROLOGICAL SURGERY, ORTHOPEDIC SURGERY, OTOLARYNGOLOGY, PLASTIC SURGERY, COLON AND RECTAL SURGERY, THORACIC SURGERY, UROLOGY, AND ANESTHESIOLOGY.
3/ INCLUDES ALLERGY, CARDIOVASCULAR DISEASES, DERMATOLOGY, GASTROENTEROLOGY, PEDIATRIC ALLERGY, PEDIATRIC CARDIOLOGY, PULMONARY DISEASES, RADIOLOGY, DIAGNOSTIC RADIOLOGY, THERAPEUTIC RADIOLOGY, NEUROLOGY, PHYISICAL MEDICINE AND REHABILITATION, AND "OTHER SPECIALTIES."
4/ INCLUDES OCCUPATIONAL MEDICINE, GENERAL PREVENTIVE MEDICINE, PUBLIC HEALTH, AEROSPACE MEDICINE, FORENSIC PATHOLOGY AND PATHOLOGY.

T53C. Total projected requirements for physicians (MD's and DO's) by health services category in 1980, 1985, 1990

	REQUIREMENTS ESTIMATES							
	1975		1980		1985		1990	
	BASIC	REVISED	BASIC	REVISED	BASIC	REVISED	BASIC	REVISED
CARE CATEGORIES	354812	378376	412018	438835	480637	511295	561092	596217
MEDICAL OFFICE	196196	205196	232564	243203	279744	292568	336520	352002
GENERAL CARE /1	57565	59435	67698	69897	80591	83208	96249	99377
PEDIATRIC CARE	21500	23258	23693	25630	27671	29933	33368	36096
OBSTETRIC & GYN. CARE	16302	17200	20492	21622	25154	26540	30159	31821
PSYCHIATRIC CARE	15115	16251	18289	19665	23263	25012	28945	31122
VISION CARE	8844	9335	10993	11604	13602	14358	16813	17747
OTHER CARE /2	76870	79717	91399	94785	109463	113517	130986	135839
SHORT TERM HOSP. CARE /3	109638	117573	129313	138712	149651	160554	172380	184957
LONG TERM CARE /4	13408	14162	14335	15144	15181	16040	15896	16796
OTHER /5	35570	41445	35806	41776	36061	42133	36296	42462

1/ PHYSICIAN OFFICE VISITS TO GENERAL PRACTITIONERS, INTERNISTS, AND OSTEOPATHIC PHYSICIANS.

2/ ALL PHYSICIAN OFFICE VISITS REPORTED IN ADDITION TO THOSE IDENTIFIED IN THE SPECIFIED CATEGORIES, AND OUTPATIENT HOSPITAL VISITS.

3/ INCLUDES OUTPATIENT CARE AND MEDICAL AND SURGICAL INPATIENT CARE.

4/ INCLUDES PSYCHIATRIC HOSPITAL CARE, NURSING HOME CARE, AND "OTHER" LONG TERM CARE (SEE TEXT).

5/ INCLUDES NONCARE ACTIVITIES (TEACHING, RESEARCH, ADMINISTRATION, AND NONCARE CIVILIAN GOVERNMENT EMPLOYMENT NOT ELSEWHERE CLASSIFIED), BIRTH CONTROL CLINICS, AND NEIGHBORHOOD HEALTH CENTERS, AND SIMILAR COMMUNITY HEALTH CLINICS.

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